



AERONAUTICAL ENGINEERING

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WITH INDEXES

Supplement 32

JUNE 1973

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AERONAUTICAL ENGINEERING

A Special Bibliography

Supplement 32

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced in May 1973 in

- *Scientific and Technical Aerospace Reports (STAR)*
- *International Aerospace Abstracts (IAA).*



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INTRODUCTION

Under the terms of an interagency agreement with the Federal Aviation Administration this publication has been prepared by the National Aeronautics and Space Administration for the joint use of both agencies and the scientific and technical community concerned with the field of aeronautical engineering. The first issue of this bibliography was published in September 1970 and the first supplement in January 1971. Since that time, monthly supplements have been issued.

This supplement to *Aeronautical Engineering—A Special Bibliography* (NASA SP-7037) lists 372 reports, journal articles, and other documents originally announced in May 1973 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*.

The coverage includes documents on the engineering and theoretical aspects of design, construction, evaluation, testing, operation, and performance of aircraft (including aircraft engines) and associated components, equipment, and systems. It also includes research and development in aerodynamics, aeronautics, and ground support equipment for aeronautical vehicles.

Each entry in the bibliography consists of a standard bibliographic citation accompanied in most cases by an abstract. The listing of the entries is arranged in two major sections, *IAA Entries* and *STAR Entries*, in that order. The citations, and abstracts when available, are reproduced exactly as they appeared originally in *IAA* or *STAR*, including the original accession numbers from the respective announcement journals. This procedure, which saves time and money, accounts for the slight variation in citation appearances.

Three indexes—subject, personal author, and contract number—are included.

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All publications abstracted in this bibliography are available to the public through the sources as indicated in the *STAR Entries* and *IAA Entries* sections. It is suggested that the bibliography user contact his own library or other local libraries prior to ordering any publication inasmuch as many of the documents have been widely distributed by the issuing agencies, especially NASA. A listing of public collections of NASA documents is included on the inside back cover.

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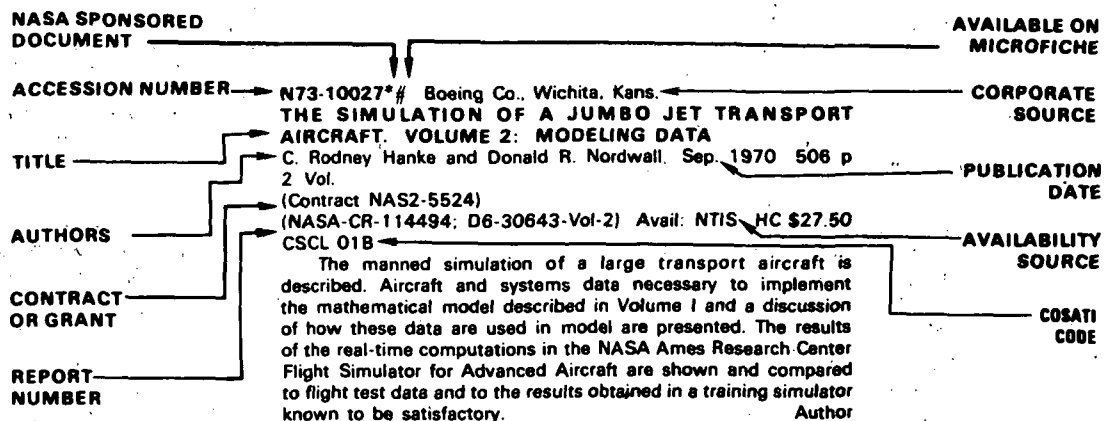
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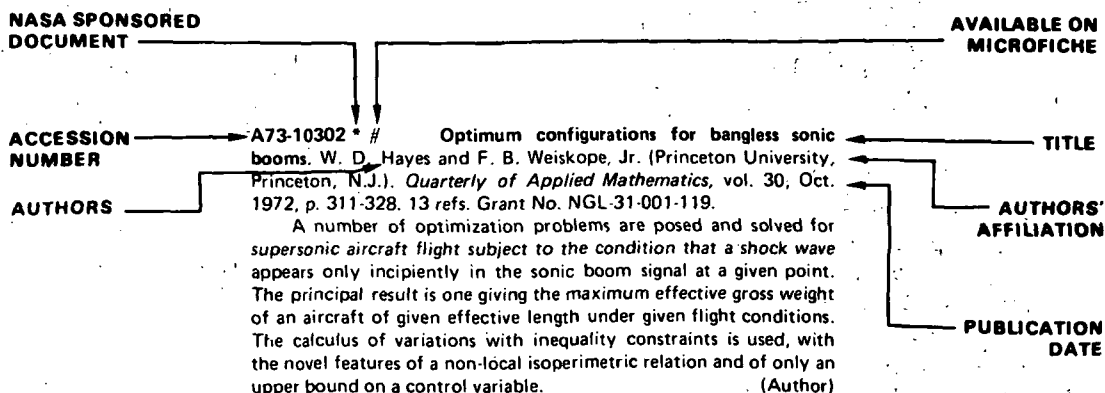
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TYPICAL CITATION AND ABSTRACT FROM IAA





AERONAUTICAL ENGINEERING

A Special Bibliography (Suppl. 32)

JUNE 1973

IAA ENTRIES

A73-21947 Source selection process faces winds of change. J. T. Stewart (USAF, Aeronautical Systems Div., Wright-Patterson AFB, Ohio). *Defense Management Journal*, vol. 9, Jan. 1973, p. 13-16.

Experiences of the Aeronautical Systems Division of the Air Force Systems Command regarding the lightweight fighter acquisition process are used to illustrate efforts to simplify requests for proposals (RFP) and streamline the source selection process. Straightforward RFPs are discussed together with benefits of limited size, data sources, questions of proposal scoring, and aspects of future use. G.R.

A73-21992 Slender delta-wings for future subsonic passenger planes (Schlanke Delta-Flügel für zukünftige Unterschall-Verkehrsflugzeuge). M. Lichte (Vereinigte Flugtechnische Werke-Fokker GmbH, Bremen, West Germany). *Flug Revue/Flugwelt International*, Feb. 1973, p. 27-30, 35-37. In German.

A73-22165 # Influence of regulated unequal guide-vane spacing on the alternating stress level in the working blades of a compressor (O vliiamii reguliruemoi raznoshagovosti v napravliaushchem apparate na uroven' peremennykh napriazhenii v rabotikh lopatkakh kompressora). V. N. Tiulenév and V. A. Skibin (Tsentral'nyi Nauchno-Issledovatel'skii Institut Aviatsionnogo Motostroeniia, Moscow, USSR). *Problemy Prochnosti*, vol. 4, Dec. 1972, p. 102-105. In Russian.

A73-22166 # A case of failure of gas-turbine-engine turbine disks (Ob odnom sluchae razrusheniia turbinnykh diskov gazoturbinnogo dvigatel'ia). Ch. L. Svetlakov, A. G. Makhnev, and V. F. Kozhevnikov. *Problemy Prochnosti*, vol. 4, Dec. 1972, p. 106-110. In Russian.

Cracks were observed to form on the downstream face of the rotor disk of a low-power single-stage turbine, in a groove between two coaxial circular ridges used to press fit a rotor bearing. An experimental investigation is described in which the stress distribution and stress concentration factors at the center of the disk were determined by an optical polarization technique. The results led to an improved disk design in which the groove was eliminated. V.P.

A73-22176 1972 report to the aerospace profession; Proceedings of the Sixteenth Symposium, Beverly Hills, Calif.,

September 28-30, 1972. Symposium sponsored by the Society of Experimental Test Pilots. *Society of Experimental Test Pilots, Technical Review*, vol. 11, no. 2, 1973. 256 p.

Testing of the F-15 fighter, the autorotation characteristics of the AH-56A compound helicopter, the development and flight test of a digital fly-by-wire F-8, the role of the test pilot in evaluating automatic landing systems, and flight research to develop airworthiness standards for civil aircraft receive attention. The flutter-free flight envelope of the STOL Arava aircraft is studied. Results of Apollo 16 are given, and the joint US/USSR docking mission is discussed, together with the Skylab project and the space shuttle program.

F.R.L.

A73-22177 Survivable flight control system. C. P. Garrison (McDonnell Douglas Corp., St. Louis, Mo.). (*Society of Experimental Test Pilots, Symposium, 16th, Beverly Hills, Calif., Sept. 28-30, 1972.*) *Society of Experimental Test Pilots, Technical Review*, vol. 11, no. 2, 1973, p. 1-19.

Review of the design and flight test philosophy, present status and future trends of the projected survivable flight control system for fighter aircraft. A description of the test vehicle is followed by a discussion of the results of the flight test program. Observations regarding the future of redundant, full-authority, motion-feedback control systems conclude the review. M.V.E.

A73-22178 F-15 air superiority fighter briefing. I. L. Burrows (McDonnell Douglas Corp., Edwards, Calif.). (*Society of Experimental Test Pilots, Symposium, 16th, Beverly Hills, Calif., Sept. 28-30, 1972.*) *Society of Experimental Test Pilots, Technical Review*, vol. 11, no. 2, 1973, p. 21-28.

Some pertinent events concerning the testing of the F-15 Eagle fighter are reviewed, and the aircraft and its systems are described. The air inlet system consists of a series of ramps plus a bypass door which are automatically scheduled to provide optimum shock wave and airflow control. The control system makes use of a high authority Control Augmentation System (CAS) superimposed on a mechanical system. The systems have been remarkably trouble free, and there have been no forced engine changes. Correlation with wind tunnel data has been good. F.R.L.

A73-22179 AH-56A Compound Helicopter autorotation characteristics. D. R. Segner (Lockheed-California Co., Burbank, Calif.). (*Society of Experimental Test Pilots, Symposium, 16th, Beverly Hills, Calif., Sept. 28-30, 1972.*) *Society of Experimental Test Pilots, Technical Review*, vol. 11, no. 2, 1973, p. 29-47. 5 refs.

The AH-56A Compound Helicopter is described with emphasis on the configuration items unique to this vehicle which affect autorotation characteristics. The Beta propeller, rigid rotor, and the wing are discussed in particular detail. The steady state autorotation descent performance is discussed with emphasis on the analysis and piloting task introduced by the addition of the propeller as an added variable in the performance definition. Autorotation entries are discussed in both the helicopter and compound modes of operation.

An engineering test pilot description of the flight test build-up program is presented including the logical engineering progression from entries in low power descents to increasingly critical entries, culminating in entries at maximum airspeed. (Author)

A73-22180 * Development and flight test of a digital fly-by-wire F8. B. A. Peterson, G. E. Krier, and C. R. Jarvis (NASA, Washington, D.C.). (*Society of Experimental Test Pilots, Symposium, 16th, Beverly Hills, Calif., Sept. 28-30, 1972.*) *Society of Experimental Test Pilots, Technical Review*, vol. 11, no. 2, 1973, p. 57-71.

The objective of the F-8 digital fly-by-wire program is to establish a technology base for the implementation of advanced flight control systems. The central element is the Apollo Lunar Guidance Computer (LGC). This versatile computer ran over 2000 hours in support of fly-by-wire without a failure. Difficulties encountered in the first flights were corrected rapidly and simply by changes in the erasable software memory. Control-configured vehicles offer significant weight-saving possibilities. F.R.L.

A73-22181 A case for more qualitative flight testing. F. T. Bryan (U.S. Marine Corps, Naval Air Training Command, Patuxent River, Md.). (*Society of Experimental Test Pilots, Symposium, 16th, Beverly Hills, Calif., Sept. 28-30, 1972.*) *Society of Experimental Test Pilots, Technical Review*, vol. 11, no. 2, 1973, p. 73-81.

In a complex 'numbers' oriented program, the art of qualitative flight testing in describing a new aircraft's flying qualities is essential, for without an accurate word picture of the flying qualities, the 'numbers' only serve to indicate specification compliance. Spin test programs provide excellent examples of qualitative flying qualities descriptions. Static longitudinal stability offers a good example of pilot comments documented with quantitative data. Many problems may not require extensive instrumentation systems. F.R.L.

A73-22182 The role of the test pilot in evaluating auto landing systems. I. P. S. Norton (Lockheed Aircraft Corp., Burbank, Calif.). (*Society of Experimental Test Pilots, Symposium, 16th, Beverly Hills, Calif., Sept. 28-30, 1972.*) *Society of Experimental Test Pilots, Technical Review*, vol. 11, no. 2, 1973, p. 83-100.

Automatic Carrier Landing System (ACLS) operation, theory, and testing sequences are discussed and interpreted. The test pilot is intimately concerned with the cockpit and basic flight navigation instruments and displays since he is continually required to monitor the aircraft's position during the approach. He should have an appreciation for the operation of the entire system and become familiar with the operating characteristics and limitations of each component in this system. Although he is evaluating the aircraft's response and control, he can only observe, not affect it. The most valuable contribution the pilot can make is to offer his judgment and criteria to the engineer. F.R.L.

A73-22183 The role of the test pilot in evaluating auto landing systems. II. W. F. Smith (Lockheed Aircraft Corp., Burbank, Calif.). (*Society of Experimental Test Pilots, Symposium, 16th, Beverly Hills, Calif., Sept. 28-30, 1972.*) *Society of Experimental Test Pilots, Technical Review*, vol. 11, no. 2, 1973, p. 101-114.

In development of an automatic landing system, a test pilot assumes the two primary responsibilities of helping develop the most technically effective system possible and assuring that the system meets the real-life requirements demanded of it by the commercial airline pilot. Paramount factors that govern the test pilot's assessments of the system, are, in order of importance, flight safety, as reflected by reliability and performance characteristics, and maintainability. Of nearly equal concern to the evaluating test pilot, however, is the requirement for optimum flight crew convenience. The growing complexity of advanced and sophisticated commercial aircraft, along with the drive toward full zero-zero landing operations, demand that every aspect of flight station layout and operating procedure be viewed through the eyes of the airline pilot who must fly the aircraft under all weather conditions on a routine, day-to-day basis. (Author)

A73-22184 Flight research to develop airworthiness standards for civil aircraft. D. A. Tuck (FAA, Washington, D.C.). (*Society of Experimental Test Pilots, Symposium, 16th, Beverly Hills, Calif., Sept. 28-30, 1972.*) *Society of Experimental Test Pilots, Technical Review*, vol. 11, no. 2, 1973, p. 115-122. 5 refs.

The Headquarters Flight Test Branch of the FAA has been engaged in research programs to gain the knowledge and experience needed to establish the performance and flying qualities certification requirements for the next generation of civil aircraft such as the supersonic transports and STOL aircraft. The roles of the NASA flight simulator for advanced aircraft (FSAA) are described, as well as that of the USAF/Cornell Total in-Flight Simulator (TIFS). F.R.L.

A73-22185 STOL Arava - Flutter-free flight envelope. D. C. Levine (Israel Aircraft Industries, Ltd., Lydda, Israel). (*Society of Experimental Test Pilots, Symposium, 16th, Beverly Hills, Calif., Sept. 28-30, 1972.*) *Society of Experimental Test Pilots, Technical Review*, vol. 11, no. 2, 1973, p. 123-125.

The recording and measurement system of the 20-passenger Arava twin-engined STOL transport flutter flight test program is described in detail. The mainstay of the instrumentation system is the accelerometer, and the second important component is a conditioner with a built-in filter mounted on an electronic printed card. The excitation and oxygen systems, and the data reduction and analysis processes are discussed. Flutter flight tests are more hazardous than conventional developmental flights, and special precautions are needed. F.R.L.

A73-22197 The nature of a fighter aircraft. P. Sprey. *Interavia*, vol. 28, Feb. 1973, p. 145-147.

The characteristics of an air battle fighter are described. It is pointed out that a very high quality fighter can be built cheaply and easily if it is done correctly. However, despite its great utility in war no really superior fighter aircraft has been produced in the last 15 years by any nation. The basic traits that create a visual air battle fighter are considered, giving attention to lethality, maneuverability, stealth, range, battle persistence, visibility, presence (numbers), resilience, sortie rate, handling qualities, fire control system, and tactical doctrines. G.R.

A73-22198 Report on the F-15 programme. I. L. Burrows (McDonnell Aircraft Co., St. Louis, Mo.). *Interavia*, vol. 28, Feb. 1973, p. 148, 149.

The F-15 has a clean gross take-off weight of 40,000 lb. Power is provided by two YF100 engines, the production version of which will be in the 25,000 lb thrust class. The air inlet system consists of a series of ramps, plus a bypass door, which are automatically scheduled to provide optimum shock wave and airflow control. The flight control system is discussed, together with the landing gear, the flaps the cockpit, and the speed brake. Preliminary results obtained with the aircraft are also considered. It was found that the control systems were extremely reliable. Adequate landing capabilities have been demonstrated under most of the failure modes possible within the control systems. G.R.

A73-22201 Association Technique Maritime et Aéronautique, Session, 72nd, Ecole Nationale Supérieure de Techniques Avancées, Paris, France, May 15-19, 1972, Proceedings. *Association Technique Maritime et Aéronautique, Bulletin*, no. 72, 1972. 616 p. In French.

Brazing of special parts in a fluorinated reducing atmosphere, self-contained submergeable energy sources, prediction of aeroelastic instabilities, and aspects of rotors and structures of helicopters are considered. Attention is given to drag reduction by flexible walls and to French projects for hydrofoil vehicles. The transverse flow around an airfoil is calculated, taking account of the exact law of compressibility. A method for experimental study of transonic cascades of blades is developed, and unsteady flow around an airfoil or a cascade is studied. Optimization of gas turbine combustors, application of the finite element method to the study of elastic

buckling, and application of a singular perturbation method to the study of beginning cavitation are discussed.

F.R.L.

A73-22202 Study and realization of special parts for aerospace construction by brazing in a fluorided reducing atmosphere (Etude et réalisation de pièces spéciales de construction aérospatiale par brasage en atmosphère réductrice fluorée). P. Galmiche (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). (*Association Technique Maritime et Aéronautique, Session, 72nd, Paris, France, May 15-19, 1972.*) *Association Technique Maritime et Aéronautique, Bulletin*, no. 72, 1972, p. 81-95; Discussion, p. 96. In French.

The principle, general characteristics, and fields of application of the technique of brazing stainless steels in a fluorided atmosphere are discussed. Reducing treatment atmospheres fluorided to the reduction equilibrium of metallic fluorides, most often chromous fluoride, are used. The technique requires an operating temperature of at least 700 C. It is not suitable for ceramic materials or for titanium or zirconium. Results on light refractory materials of impervious honeycomb structure, coatings for turbojet casings, graphite-graphite or graphite-metal assemblies, and on ultra-refractory structure parts in thin corrugated sheets of dispersed-phase alloys are given. F.R.L.

A73-22204 Prediction of aeroelastic instabilities in turbines (Prévision des instabilités aéroélastiques dans les turbomachines). J. Leclerc (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). (*Association Technique Maritime et Aéronautique, Session, 72nd, Paris, France, May 15-19, 1972.*) *Association Technique Maritime et Aéronautique, Bulletin*, no. 72, 1972, p. 141-164; Discussion, p. 165. In French.

A theoretical study is described which in principle makes it possible to predict a certain type of instability in undetached subsonic flow, and which can characterize the sensitivity to forced excitations while furnishing coefficients of aerodynamic damping. The importance of the concept of damping by interaction of the blades is shown. The problem of the determination of dampings for basic configurations has been solved in a slightly diverted compressible two-dimensional flow across an infinite rectilinear grill. Results which are of practical interest are given. F.R.L.

A73-22205 Theoretical determination of the characteristics of helicopter rotors (Détermination théorique des caractéristiques des rotors d'hélicoptères). R. Hirsch. (*Association Technique Maritime et Aéronautique, Session, 72nd, Paris, France, May 15-19, 1972.*) *Association Technique Maritime et Aéronautique, Bulletin*, no. 72, 1972, p. 167-185; Discussion, p. 186-188. In French.

The problem of the detailed calculation of the characteristics and performance of a helicopter rotor in horizontal translation is considered, making use of previously developed methods of calculation of free or streamlined propellers. The configuration of the wake and induced velocities are discussed, and simplifying hypotheses are defined. Attention is given to the unsteady character of the problem. A wake model, effects of viscosity on the wake configuration and the circulation, the contribution of unsteady terms in local loads, and comparison of theory and experiment are presented graphically. F.R.L.

A73-22206 Dynamic analysis of helicopter structures (Analyse dynamique des structures d'hélicoptères). B. Simon (Société Nationale Industrielle Aérospatiale, Paris, France). (*Association Technique Maritime et Aéronautique, Session, 72nd, Paris, France, May 15-19, 1972.*) *Association Technique Maritime et Aéronautique, Bulletin*, no. 72, 1972, p. 189-204; Discussion, p. 205. 8 refs. In French.

Programs for calculation of structures by the displacement method constitute a means of determining the principal vibratory

modes. They make possible a preliminary exploration of the dynamic characteristics of helicopters before the structure is available for test. Based on the theorems of energy applied to a modelization by finite elements, a general calculation program was developed. The calculation is applied to an existing helicopter, and results are compared with those obtained from vibration tests on the ground. F.R.L.

A73-22210 Calculation of the transonic flow around an airfoil, taking account of the exact law of compressibility (Calcul de l'écoulement transonique autour d'un profil en admettant la loi de compressibilité exacte). T. S. Luu, G. Coulmy, and A. Dulieu (CNRS, Laboratoire d'Informatique pour la Mécanique et les Sciences de l'Ingénieur, Châtillon-sous-Bagneux, Hauts-de-Seine, France). (*Association Technique Maritime et Aéronautique, Session, 72nd, Paris, France, May 15-19, 1972.*) *Association Technique Maritime et Aéronautique, Bulletin*, no. 72, 1972, p. 269-281; Discussion, p. 282-284. 12 refs. In French.

The equation governing the velocity potential is established in a Poisson form, and the possibility of creating this potential by a distribution of singularities which allows translating the conditions to the limits by integral equations is demonstrated. A practical method of solution of these equations by discretization of the distributions of singularities is developed. Different examples of application are given both for subcritical and supercritical regimes without shock, which makes it possible to appraise the validity and the possibilities of the method. F.R.L.

A73-22212 Unsteady nonlinear flow around an airfoil or a blade cascade with emission of turbulent vortices (Ecoulement instationnaire non linéaire autour d'un profil ou d'une grille d'aube avec émission de tourbillons libres). T. S. Luu (CNRS, Laboratoire d'Informatique pour la Mécanique et les Sciences de l'Ingénieur, Châtillon-sous-Bagneux, Hauts-de-Seine, France) and J. Corniglion (Centre d'Etude Technique des Industries Métallurgiques, Paris, France). (*Association Technique Maritime et Aéronautique, Session, 72nd, Paris, France, May 15-19, 1972.*) *Association Technique Maritime et Aéronautique, Bulletin*, no. 72, 1972, p. 301-313; Discussion, p. 314, 315. 9 refs. In French.

As a first phase of the program relating to passing blades with vortex escape, the problem of bidimensional flow with potential of an incompressible fluid around airfoils or cascades activated by any motion, in the case of a vortex escape, is treated. A method of calculation is developed which makes it possible, by the kinematic and dynamic application of the Kutta-Joukowski condition, to determine the intensity of free vortices emitted at the trailing edge, and to determine the velocity of escape which is parallel either with the upper or lower surface of the wing, according to the sign of the vortex. F.R.L.

A73-22213 Optimization of combustors of gas turbines (Optimisation des foyers de turbines à gaz). M. Barrere (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). (*Association Technique Maritime et Aéronautique, Session, 72nd, Paris, France, May 15-19, 1972.*) *Association Technique Maritime et Aéronautique, Bulletin*, no. 72, 1972, p. 337-363; Discussion, p. 364-368. 14 refs. In French.

Study of the optimal combustor is carried out as a function of the length of the combustor and the efficiency of combustion, the fall of cutoff pressure across the combustor, wall cooling, and pollution. Two types of combustor are examined: one corresponds to the conventional type which equips present turbojets; the other approximates combustors used in liquid propellant rocket propulsion. By schematization of combustion phenomena, the geometry of the combustion is determined as a function of the minimal loss of charge. The parameters acting on the efficiency of film cooling are considered. A combustion arrangement reducing the concentration of polluting substances is proposed. F.R.L.

A73-22216 Aviation and atmospheric pollution - The real dimension of the problem and its solutions (Aviación y contami-

nación atmosférica - Dimensión real del problema y soluciones). J. A. Martínez Cabeza. *Revista de Aeronáutica y Astronáutica*, vol. 33, Jan. 1973, p. 5-20. In Spanish.

It is pointed out that the contribution of aviation to total planetary pollution is about 1 per cent. The percentage of aircraft-produced pollution is, of course, much higher at the airport. However, an investigation recently conducted at the London airport of Heathrow showed that the level of pollutants present would be considered admissible by any municipal standards. The principles of operation of a jet engine are discussed, together with the generation of engine emissions. The amount of air pollutants produced by an aircraft under certain performance conditions is shown in a graph for the time from 1950 to 1975. It is found that a very substantial decrease in pollutant emission was obtained with the introduction of more advanced types of engines. Approaches for reducing the amounts of harmful engine emissions even further are considered, and the consequences of the use of higher altitudes by the SST are examined. G.R.

A73-22233 # Aircraft parameter identification - A variational procedure. R. E. Bach, Jr. (Northeastern University, Boston, Mass.), S. E. Post (U.S. Army, Air Mobility Research and Development Laboratory, Moffett Field, Calif.), and J. E. Tucker (U.S. Naval Postgraduate School, Monterey, Calif.). In: *Annual Allerton Conference on Circuit and System Theory*, 10th, Monticello, Ill., October 4-6, 1972, Proceedings. Urbana, University of Illinois, 1972, p. 507, 508.

Construction of a smoothing algorithm for aircraft parameter identification which is based on a variational optimization procedure. A convergent iterative procedure for estimating the desired parameters from measurements which are such as to minimize a certain criterion is outlined, and a strategy for estimation of the states, parameters, and noise statistics is formulated. A.B.K.

A73-22234 # Application of four methods for approximating optimal feedback gains. J. H. Burghart (New York, State University, Buffalo, N.Y.). In: *Annual Allerton Conference on Circuit and System Theory*, 10th, Monticello, Ill., October 4-6, 1972, Proceedings. Urbana, University of Illinois, 1972, p. 520-529, 14 refs.

Investigation of the effects of various criteria for adjusting optimal feedback gains in the presence of parameter variations requiring such adjustment. Four different criteria for obtaining polynomial approximations for the optimal gains are considered. Three of these criteria are based on values of the cost function for various conditions of parameter variation, while the fourth is a conventional curve-fitting criterion for matching the optimal gains. The four criteria are applied to an example involving the longitudinal control of the X-15 aircraft during reentry. The results for all four criteria are superior to those of the functional expansion method. Conclusions regarding the effectiveness of the various criteria and the differences resulting from their application are discussed. A.B.K.

A73-22349 # The aircraft and its natural and climatic environment (Samolet i prirodno-klimaticheskie usloviia). K. M. Shpilev and A. B. Kruglov. Moscow, Voenizdat, 1972. 176 p. 46 refs. In Russian.

The effects of environmental factors on the operational fitness, systems performance, and maintenance and servicing requirements of modern aircraft are discussed on the basis of available Soviet and worldwide data. Particular attention is given to the adverse influences of the environment of other geographic regions in which aircraft designed for Europe are operated. Difficulties are considered which may arise when aircraft of European make are operated in polar regions, in African and Asian deserts, and the tropical portions of the Pacific and Atlantic. The adverse factors considered include air temperature and humidity, solar activity and insolation, atmospheric electricity and precipitation, topsoil strength and composition, dust and wind, topsoil and water salinization, and biological factors. Design and maintenance suggestions are given to cope with these problems. V.Z.

A73-22375 # Transport aircraft maintainability (Ekspluatatsionnaia tekhnologichnost' transportnykh samoletov). N. N. Smirnov and I. K. Mulkinzhanov. Moscow, Izdatel'stvo Transport, 1972. 208 p. 49 refs. In Russian.

Reliability, maintainability and servicing problems of existing and visualized transport aircraft are discussed with the emphasis on the reduction of labor, cost and time required for maintenance of operating aircraft without a quality tradeoff. Maintainability criteria are suggested for various inspection, and repair operations on aircraft components and systems. The topics also include the idle time due to maintenance work, maintenance cycle schedules, and maintenance procedures and practices adopted abroad. The theoretical and practical aspects of transport aircraft maintainability are considered. The book is intended for maintenance engineers and designers in the aviation industry. V.Z.

A73-22432 # Fluctuating lift and moment coefficients for cascaded airfoils in a nonuniform compressible flow. S. Fleeter (General Motors Corp., Detroit Diesel Allison Div., Indianapolis, Ind.). *Journal of Aircraft*, vol. 10, Feb. 1973, p. 93-98. 10 refs. USAF-supported research.

The effects of compressibility on both the fluctuating lift and the fluctuating moment coefficients for cascaded airfoils due to an upstream nonuniformity are determined by obtaining a solution to the time-dependent, compressible, two-dimensional partial differential equation which describes the perturbation velocity potential. This is accomplished through an application of Fourier-transform theory, with the resulting integral solution equation evaluated numerically by a matrix-inversion technique. The results presented show the variation in both the fluctuating lift and the fluctuating moment coefficients over the mean cascade inlet Mach number range of 0.0 (incompressible) to 0.9 with the cascade solidity, cascade stagger angle, interblade phase angle and reduced frequency as parameters. (Author)

A73-22433 # Calculation of forces on stores in the vicinity of aircraft. H. Serbin. *Journal of Aircraft*, vol. 10, Feb. 1973, p. 123, 124.

The crossflow velocity field around the isolated aircraft is calculated. The cross section of the aircraft is mapped into a slit by a sequence of conformal transformations. The store itself is regarded as a slender body in the (nonuniform) flowfield of the aircraft. The vortices trailing from the lifting surfaces on the store are taken into account. The forces and moments are found by suitable integrations of the loading. G.R.

A73-22434 # Toward simpler prediction of transonic airfoil lift, drag, and moment. F. O. Smetana and D. P. Knepper (North Carolina State University, Raleigh, N.C.). *Journal of Aircraft*, vol. 10, Feb. 1973, p. 124-126. 8 refs.

A method utilizing semiempirical correlations of experimental data has been employed to predict the aerodynamic characteristics of wings in the case of operation at transonic speeds. The procedure includes a computation of the pressure distribution at $M = 0$, a computation of the pressure distribution at $M = 1.0$, a computation of pressure variations, and a computation of Reynolds number at the shock. G.R.

A73-22435 # Correlation of wing-body combination lift data. L. M. Nicolai and F. Sanchez (U.S. Air Force Academy, Colorado Springs, Colo.). *Journal of Aircraft*, vol. 10, Feb. 1973, p. 126-128. 9 refs.

An experimental investigation conducted shows that an equation concerning the wing-body lift interference factor indicated by the theory of Pitts, Nielsen, and Kaattari (1959) is indeed valid. Delta wing-body combinations of various aspect ratio were studied at subsonic Mach numbers and supersonic Mach numbers of 1.44, 2.48, and 3.48. All of the wing-body configurations considered in the investigation were uncambered and untwisted. G.R.

A73-22447 # Aeromechanical measurements in free flight on piloted aircraft (Masuratori aeromecanice in zbor liber pe avioane pilotate). A. Marinescu (Institutul de Mecanica a Fluidelor si Constructii Aerospatiale, Bucharest, Rumania). *Transporturi Auto, Navale si Aeriene*, vol. 2 (19), Oct. 1972, p. 546-554. 5 refs. In Rumanian.

Review of methods of measuring the essential parameters of piloted aircraft in transonic flight. The methods discussed concern the measurement of pressure with the aid of pitot tubes and altimeters, the measurement of temperature and speed, the measurement of thrust by measuring the total static pressure and the temperature in the neighborhood of the engine jet or by measuring the static pressure in the free stream and the total static pressure and the temperature in the outlet section of the engine jet, the measurement of drag with the aid of accelerometers, the measurement of lift, and the measurement of the aircraft control and stability characteristics. A.B.K.

A73-22502 A new digital pressure transducer. R. C. Meyer (United Aircraft Corp., Hamilton Standard Div., Windsor Locks, Conn.). In: Instrument Society of America, Annual Conference, 27th, New York, N.Y., October 9-12, 1972, Proceedings. Part 2. Pittsburgh, Instrument Society of America, 1972, p. 601.1-601.15.

This paper discusses the design features of the Hamilton Standard digital pressure transducer. The vibrating cylinder pressure sensing element and its theory of operation are explored - i.e., how pressure changes the natural vibratory frequency of the sensing element and how this is converted into an electrical response signal. The many variations of signal output available from the digital transducer are discussed. Two interesting applications are discussed wherein the transducer was used to make a difficult measurement. One is that of nuclear reactor containment leakage testing, and the other is the use of the transducer in air inlet controls for high performance aircraft. (Author)

A73-22504 * Development of a high temperature fatigue sensor. T. L. Wells, R. F. Canon, G. C. Rolls (Tracor, Inc., Austin, Tex.), and E. J. Wilson (NASA, Flight Research Center, Edwards, Calif.). In: Instrument Society of America, Annual Conference, 27th, New York, N.Y., October 9-12, 1972, Proceedings. Part 2. Pittsburgh, Instrument Society of America, 1972, p. 603.1-603.6. 11 refs. Contract No. NAS4-1796.

An experimental program was conducted to extend the Tracor Safety Gauge (patent pending) to elevated temperature service. The Safety Gauge is based on a conductive composite device which can be fabricated to function as a fatigue sensor that undergoes an irreversible resistance increase which results from cumulative strain damage. Prototype sensors were developed which appear capable of 1000 deg F operation for short periods of time (approaching one hour); however, bonding difficulties currently limit their use to about 775 deg F. The resistance change of the sensor was generally on the order of 400% or greater as the fatigue life of a titanium alloy (Ti-5Al-2.5Sn) test specimen was approached. (Author)

A73-22506 Pre-fab strain gage bridges. L. A. Watson (Vought Aeronautics Co., Dallas, Tex.). In: Instrument Society of America, Annual Conference, 27th, New York, N.Y., October 9-12, 1972, Proceedings. Part 2. Pittsburgh, Instrument Society of America, 1972, p. 615.1-615.4.

Description of a system of strain gage bridge buildup designed to overcome such problems as those associated with inaccessibility to installation area, time schedules that do not permit the necessary downtime for instrumentation, and parts that are difficult to remove for instrumentation. Called the prefabricated strain gage bridge, the system has been successfully applied to various tasks involving time and environment restrictions. These tasks include horizontal tail vibration tests, wing load surveys, and tail boom gage installations. M.V.E.

A73-22519 High modulus organic fibre composites in aircraft applications. J. W. Moore and D. L. G. Sturgeon (Du Pont de Nemours and Co., Inc., Carothers Research Laboratory, Wilmington, Del.). *Composites*, vol. 4, Jan. 1973, p. 34-38. 7 refs.

PRD-49 is a high strength, high modulus, low density organic fiber developed by Du Pont, that combines the processibility normally associated with conventional textiles with the plastics-reinforcing performance previously available only with inorganic fibers such as glass and graphite. It is commercially available in the form of continuous yarns, rovings, fabrics and resin preimpregnated products including collimated tapes. PRD-49 is nonconductive, flame resistant, has high chemical and thermal stability, outstanding creep rupture characteristics, good fatigue performance, notch insensitivity and damage tolerance provided by its polymeric character. (Author)

A73-22524 STOL Seminar, St. Louis, Mo., March 24, 1972, Record. Seminar sponsored by the Chamber of Commerce of Metropolitan St. Louis and St. Louis Research Council. St. Louis, Mo., St. Louis Regional Commerce and Growth Association. 1972. 118 p. \$7.50.

The prospects of short takeoff and landing aircraft and the promise they hold for future air travel are considered. Presently over fifty per cent of the air passenger traffic operates between points within a 500-mile radius of St. Louis. STOL is being designed to meet this short haul service. A broad overview of the present state of development of STOL is given and the R and D policies of the various countries as they may relate to financing or encouraging future STOL development are discussed. It is shown how the aerospace industry can provide the air vehicles and assist in the development of the short haul air transportation system which will interface with the total air and ground system of the future. G.R.

A73-22567 # Computer calculation of the characteristics of multistage gas turbines (Raschet na EVM kharakteristik mnogostupenchatyykh gazovyykh turbin). G. V. Zhukovskii, Iu. N. Malyshev, and Iu. I. Novichkov. *Energomashinoströenie*, vol. 18, Oct. 1972, p. 1-3. 10 refs. In Russian.

Description of a computer program for calculating the flow and power characteristics of multistage gas turbines in both nominal and variable regimes. In the computer calculations the parameters along the mean radii of the stages are considered. In each of the calculated regimes a direct problem is solved for a given flow rate, a given rpm, and given inlet gas parameters. Using the solution obtained by successive approximations, the gas parameters at the turbine outlet are determined, and if analysis shows it to be necessary, a correction is made to the inlet parameters or the flow rate, and the calculation is repeated. A.B.K.

A73-22568 # Thermal stresses in cooled gas turbine blade foils and roots with allowance for thermoelastic effects (Temperaturnye napriazheniya v pere i khvostovike okhlazhdaemoi rabochei lopatki gazovoi turbiny s uchëtom ikh vzaimnogo termouprugogo vlianiia). N. M. Gorelkin and I. A. Bogov. *Energomashinoströenie*, vol. 18, Oct. 1972, p. 10-12. 5 refs. In Russian.

A73-22569 # Improvement of the calculation of the guide vanes of centrifugal pumps (Sovershenstvovanie rascheta napravlia-iushchikh apparatov tsentroběžnykh nasosov). N. S. Ialovoi. *Energomashinoströenie*, vol. 18, Oct. 1972, p. 14-17. 11 refs. In Russian.

Description of a method of calculating the inlet cross sections and the diffuser channels of guide vanes with allowance for nonuniformity and unsteadiness of the flow in the gap between the impeller and the guide vanes. Particular attention in this method is given to the problem of the correct choice of the relation between the expansion stage in the diffuser and the return channel and to the problem of choosing the basic geometrical dimensions of the diffuser channels of the guide vanes from the condition that the losses in the guide vanes be minimized. A.B.K.

A73-22715 # Experimental method for analyzing the unsteady flow in a transonic aircraft compressor (Méthode d'analyse expérimentale de l'écoulement instationnaire dans un compresseur aéronautique transsonique). R. Languier (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France) and C. Ruyer. *La Recherche Aérospatiale*, Nov.-Dec. 1972, p. 353, 354. In French. Research supported by the Direction des Recherches et Moyens d'Essais.

A method of probing the internal flow of a turbine to demonstrate its unsteady character is described. Information is acquired starting with a cylindrical, adjustable anemometric probe, the sensor being a piezoelectric pressure detector. The data processing includes extraction of the periodic part of the signals which are related to the passage of the rotor blades, after elimination of the random component. A precise description of the periodic fluctuations of the flow can be obtained. F.R.L.

A73-22718 Current predictive models of the dynamic environment of transportation. J. T. Foley, M. B. Gens, and C. F. Magnuson (Sandia Laboratories, Albuquerque, N. Mex.). *Journal of Environmental Sciences*, vol. 16, Jan.-Feb. 1973, p. 18, 23-28. 31 refs. AEC-supported research.

Models are developed which predict the dynamic environment experienced by cargo during transportation. A model is defined as a description of expected acceleration amplitudes vs frequency derived from measured data. Thus, a predictive model is a description of an environment which may be used to predict the levels of a specific environment which may be encountered at a given frequency or in a frequency band. In all the models described, level of environment is given as zero to peak acceleration. The dynamic environment in the transportation environment is complex. In the method of description it consists of a base of near-Gaussian, broadband, random, continuous excitation with many types of discrete excitations either superimposed or intermixed with it. F.R.L.

A73-22830 * Potentials and problems of hydrogen fueled supersonic and hypersonic aircraft. R. D. Witcofski (NASA, Langley Research Center, Hampton, Va.). In: Intersociety Energy Conversion Engineering Conference, 7th, San Diego, Calif., September 25-29, 1972, Proceedings. Washington, D.C., American Chemical Society, 1972, p. 1349-1354. 19 refs.

A73-22947 Measurements of some hydrogen-oxygen-nitrogen compounds in the stratosphere from Concorde 002. J. E. Harries (National Physical Laboratory, Teddington, Middx., England). *Nature*, vol. 241, Feb. 23, 1973, p. 515-518. 30 refs. Research supported by the Committee on the Meteorological Effects of Stratospheric Aircraft.

A73-22954 On the convergence of the Rayleigh-Ritz method in plane subsonic flow. H. Rasmussen (Danmarks Tekniske Højskole, Lyngby, Denmark). *Institute of Mathematics and Its Applications, Journal*, vol. 11, Feb. 1973, p. 1-8. 9 refs. Research supported by the Science Research Council.

The boundary value problem for plane compressible flow past an aerofoil can be formulated as a variational problem. It is shown that for subsonic flow approximate solutions obtained by the Rayleigh-Ritz method converge uniformly to the exact solution provided that the aerofoil is sufficiently smooth and the coordinate functions are properly chosen. The analysis applies also to certain other two-dimensional variational problems. (Author)

A73-22975 # Visual systems for indicating approach slope during aircraft landing (Sisteme vizuale pentru indicarea pantei de apropiere la aterizarea avioanelor). E. Hladiuc. *Transporturi Auto, Navale si Aeriene*, vol. 2(19), Nov. 1972, p. 607-611. In Rumanian.

Brief review of a widely used visual approach slope indicator system (called VASIS) and of several modifications of the basic

system. The VASIS system is placed along the sides of the runway, in the threshold zone, and is intended for executing final approaches, thus enabling the pilot to maintain a correct predetermined slope and preventing landings which are too short or too long. This system, as well as the VASIS system with three bars and the T-VASIS system, are designed for use at airports serving international traffic. The use of any particular one of these systems is dictated by the type of aircraft and, in particular, by the vertical distance between the pilot's eyes and the wheels during the roundoff phase. Each of these systems in turn has a simplified counterpart called AVASIS, AVASIS with three bars, and AT-VASIS, respectively. These latter systems are designed for airports serving domestic traffic. A.B.K.

A73-23036 Mode of thickening of a low morning convective layer in clear sky (Mode d'épaississement d'une basse couche convective matinale en ciel clair). R. Rosset, P. Mascart, H. Isaka, and R.-G. Soulage (Clermont-Ferrand, Université, Aubière, Puy-de-Dôme, France). *Académie des Sciences (Paris), Comptes Rendus, Série B - Sciences Physiques*, vol. 276, no. 6, Feb. 5, 1973, p. 223-226. 5 refs. In French.

A study of the characteristics of the upper front of the convective layer and of its ascent in the course of a morning was carried out. Thermodynamic measurements (pressure, temperature, humidity) and dynamic measurements were carried out using a light airplane. The airplane executed a succession of flights at various levels between the ground and 2000 m from dawn to the end of the morning. The convective low layers of the atmosphere appear to present in their upper part a 'convective front' which ascends in 'jumps,' at least in certain cases, depending on the stability and turbulence of thin sheets of the stable layer which it encounters. F.R.L.

A73-23089 Flowfield calculations for some supersonic sections with ducted heat addition. E. G. Broadbent (Royal Aircraft Establishment, Farnborough, Hants., England). *Ingenieur-Archiv*, vol. 42, no. 2, 1973, p. 89-103. 5 refs.

A previous investigation of external heat addition at a free stream Mach number of 7.5 and in the flowfield of selected two-dimensional sections showed that, although the net pressure drag could be reduced, it was difficult to cancel it altogether. The present investigation shows how the use of a cowl allows this to be achieved with something to spare and how, if two intake shocks are used (rather than one), sectional lift coefficients of more than 0.07 can be attained at propulsive efficiencies of about 40%. The main parameter varied is the duct slenderness. (Author)

A73-23106 # Graphoanalytic method of calculating plane potential flows (Metod grafoanaliticheskogo rascheta ploskikh potentsial'nykh techenii). A. L. Loktev. *Akademiia Nauk SSSR, Izvestiia, Energetika i Transport*, Sept.-Oct. 1972, p. 113-121. In Russian.

An equation of a flow velocity equipotential is derived from an equation of a flow velocity potential which disregards the flow compression. A procedure based on a solution to the equation of equipotential is derived for the calculation of the characteristics of a plane potential flow in a flat channel of arbitrary width with an abrupt change in the wall curvature. Theoretical considerations are given concerning the applicability of this technique to turboengine ducts and to bodies in subsonic flows. V.Z.

A73-23120 Aerial targets in use in the UK. J. S. Price (Ministry of Defence, London, England). *Royal Aeronautical Society, Symposium on Drones and Targets, London, England, Feb. 10, 1972.* *Aeronautical Journal*, vol. 77, Jan. 1973, p. 1-3.

Aerial targets may be converted aircraft, specially developed pilotless drones, or towed targets. When airborne targets are used in assessing the performance of a weapons system two essential features are that the target be compatible with the guidance system, and that a scoring system be provided to assess the effectiveness of the firing.

If an airborne target is to exercise the weapons system adequately, it must have a radar signature which is comparable with the real thing, hence the radar echo must be amplified. F.R.L.

A73-23121 The Stiletto project. F. P. Youens (Short Brothers and Harland, Ltd., Belfast, Northern Ireland). (*Royal Aeronautical Society, Symposium on Drones and Targets, London, England, Feb. 10, 1972.*) *Aeronautical Journal*, vol. 77, Jan. 1973, p. 3-15.

The Stiletto air-launched supersonic target developed for UK ranges is based on the American AQM 37A target. The AQM 37A is an expendable air launched vehicle powered by a liquid bipropellant rocket motor. The majority of AQM 37A operations are carried out using one of a number of possible trajectories, the appropriate program settings being made before the launch aircraft takes off. The main differences between the AQM 37A and Stiletto stem from three causes: (1) additional or alternative radio and radar equipment for compatibility with UK range equipment or with particular missiles, (2) changes in trajectory and flight termination procedures, and (3) improvements to enable specific trajectories to be flown to a higher degree of accuracy. F.R.L.

A73-23122 The Turana drone system. S. S. Schaetzel (Hawker de Havilland Australia Pty., Ltd., Lidcombe, New South Wales, Australia). (*Royal Aeronautical Society, Symposium on Drones and Targets, London, England, Feb. 10, 1972.*) *Aeronautical Journal*, vol. 77, Jan. 1973, p. 15-24.

Preceding Australian activity on drones and guided weapons is briefly outlined, since the approach to various problems of the Turana system and the solution of certain difficulties depended on the experience gained with the Jindivik, Malkara, and Ikara. During development trials were carried out which proved the basic Turana performance and validated the simulation model. Turana was designed as a naval target drone capable of exercising the guns and guided weapons of Australian naval vessels. It is described in detail, and the method of operation is outlined. Turana may be launched from an Ikara ship launcher or from a simple portable lightweight launcher on board ship or on the ground. F.R.L.

A73-23123 Co-existence of scheduled and charter services in public air transport. J. G. Thomka-Gazdik. *Aeronautical Journal*, vol. 77, Jan. 1973, p. 32-40. 15 refs.

It is considered that there is a need to provide low cost air transportation for the substantial segment of the traveling public which is finding its requirements met by the so-called charter services. Equally there is a need to maintain regular line services on which governments, trade, and commerce inevitably rely. It is suggested that it is not feasible to regulate bilaterally two-thirds of public transport (scheduled services) while leaving the remainder under unilateral supervision or uncontrolled. Governments have a responsibility to devise a coherent and satisfactory framework for the regulation of all international air services. F.R.L.

A73-23125 The rolling up of a trailing vortex sheet. R. R. Clements and D. J. Maull (Cambridge University, Cambridge, England). *Aeronautical Journal*, vol. 77, Jan. 1973, p. 46-51. 8 refs. Research supported by the Science Research Council.

The way in which the vortex sheet can roll up under different loading conditions was studied. The investigation was oriented towards finding circulation distributions which alter the rolling up characteristics of the sheet in such a way as to retard the rolling up and decrease the vorticity finally contained in such rolled up vortex cores. The calculations of Westwater (1935) form the basis for the study. It is shown that improvements of the order of 13 to 15% in the strength of the tip vortices may be achieved for incurred drag penalties as low as 5%. F.R.L.

A73-23224 # Fundamentals of aviation (Osnovy aviatsii). G. A. Nikitin and E. A. Bakanov. Moscow, Izdatel'stvo Transport, 1972.

280 p. 15 refs. In Russian.

The development of aviation is briefly reviewed, and the fundamentals of aerodynamics and flight theory of airplanes and helicopters are discussed. Various aircraft designs and designs of their principal components (wings, tail units, fuselages, landing gears) are studied, together with helicopter and VTOL and STOL aircraft designs. The theory of aircraft piston and jet engines is outlined. Aircraft deicing systems, hydraulic systems, electrical and communications systems, and the principal aircraft instruments are examined. V.P.

A73-23242 # Emission spectrographic analysis of used aero engine oil - A tool of maintenance. R. S. Arbuckle (Canadian Armed Forces, Toronto, Canada) and G. B. Crump (Shell Research, Ltd., Chester, England). In: *International Federation of Airworthiness Technology and Engineering, Symposium, Tunbridge Wells, Kent, England, August 31-September 2, 1972, Proceedings.* Kingston on Thames, Surrey, England, International Federation of Airworthiness Technology and Engineering, 1972, p. 4.1-4.4.

The scientific background of the Canadian Armed Forces Spectrometric Oil Analysis Program (SOAP) is described, and it is shown how the laboratory results have been applied to the detection of incipient engine failures. The wear metals measured routinely are iron, magnesium, copper, chromium, and silver. In order to ensure that the spectrographic measurements are as meaningful as possible, the used engine oils are analyzed alongside standards prepared by dissolving previously analyzed salts of the metals in question in synthetic ester oils of the type used in the J.79 engines. Of the first thirteen engines investigated from the commencement of the program, eleven supported the recommendation of the SOAP. Some case histories are given. F.R.L.

A73-23243 # Economic management. G. D. Peacock (Monarch Airlines, Ltd.; Airline Engineering, Ltd., Luton, Beds., England). In: *International Federation of Airworthiness Technology and Engineering, Symposium, Tunbridge Wells, Kent, England, August 31-September 2, 1972, Proceedings.* Kingston on Thames, Surrey, England, International Federation of Airworthiness Technology and Engineering, 1972, p. 10.1-10.4.

The subject is dealt with in terms of the operational and commercial pattern, the basic philosophy and objectives of production planning and control, the application of the principles to Airline Engineering Ltd., and budget control and analysis of results. It is recommended that every individual job be timed and controlled, and that material costings should never get more than twenty-four hours behind. F.R.L.

A73-23245 # Air-traffic-control magnetic tape recorders in civil aviation (Dispetcherskie magnitofony grazhdanskoi aviatsii). V. K. Kachan, V. V. Sokol, and Iu. V. Zinenko. Moscow, Izdatel'stvo Transport, 1972. 167 p. 29 refs. In Russian.

Description of the design features and principles of operation of multichannel magnetic tape recording/reproducing equipment used in civilian ATC centers to monitor and preserve speech communications between ground-based controllers and aircraft crewmembers. An initial exposition of magnetic recording theory covers fundamentals of field impression on magnetic media, dc and ac magnetic biasing, signal reproduction, frequency compensation, head construction, and tape transport design. The main text offers comprehensively described circuit diagrams, mechanical design layouts, and operational specifications for individual subsystems and components of specific tape recording equipment. The provision of reference time-base channels is explained in terms of equipment and procedures employed. T.M.

A73-23255 Artificial slow crack growth under constant stress - The R-curve concept in plane stress. D. Broek (Nationaal Luchtvaartlaboratorium, Amsterdam, Netherlands). *Engineering Fracture Mechanics*, vol. 5, Feb. 1973, p. 45-53. 8 refs.

A test program in which crack extension by means of sawing while the specimen was under constant load is described, and results are compared with conventional residual strength data. It was found that sawing under load could be continued far beyond the length of the crack that should be critical at the applied stress (on the basis of the residual strength curve). An energy-balance diagram is developed in terms of the energy release rate G and the crack growth resistance R . The shape of the R -curve can be determined experimentally from the G -values during slow growth, since the energy balance requires that $G = R$ during stable crack propagation. The energy concept (R -curve) is compatible with the fact that crack growth under constant load leads to a larger critical crack length than monotonic loading. F.R.L.

A73-23293 Advances in directional solidification spur usage in turbine airfoil shapes. D. N. Duhl, J. S. Erickson, and C. P. Sullivan (United Aircraft Materials Engineering and Research Laboratory, East Hartford, Conn.). *Metal Progress*, vol. 103, Mar. 1973, p. 38-40.

Discussion of a high rate solidification process which was developed to increase casting output in the production of advanced air-cooled turbine airfoils for commercial and military applications. Increased solidification rates are achieved in this process by employing a mold translation technique to enhance heat transfer. A multipart open-ended investment casting mold is attached to a water-cooled copper chill plate and is placed within a single-zone induction-heated cylindrical graphite susceptor. Hafnium additions to nickel-base superalloys enhance transverse ductility, particularly at 1,400 F. It is anticipated that the new process and Hf additions will be advantageous in the development of a wide variety of advanced alloy systems. V.Z.

A73-23295 Forging process halves material requirements. *Metal Progress*, vol. 103, Mar. 1973, p. 49, 50.

Discussion of a gatorizing process for forging titanium-alloy and superalloy jet engine parts. The process takes advantage of the superplasticity exhibited by these materials under controlled temperature-strain rate conditions. Lower amounts of input material, reduced machining, one-step forging, and relatively easy-to-meet equipment requirements are noted as the advantages of this process. V.Z.

A73-23296 Protecting metals in corrosive high-temperature environments. F. M. Miller and N. T. Bredz (Wall Colmonoy Corp., Detroit, Mich.). *Metal Progress*, vol. 103, Mar. 1973, p. 80, 82-84.

Discussion of a group of fusion-bonded coatings - Microcoat materials - which proved effective in improving the performance and service life of jet engine components and in the economical salvaging of damaged parts. The coatings, applied to lower-cost base metals, are also potential alternatives to expensive superalloys in automotive gas-turbine, thermal-reactor, and exhaust system parts. V.Z.

A73-23360 # The efficiency of using the boundary layer as the working fluid (Ob effektivnosti ispol'zovaniia pogranichnogo sloia v kachestve rabocheho tela). I. P. Mel'nichenko (Akademiia Nauk Ukrainskoi SSR, Institut Matematiki, Kiev, Ukrainian SSR). *Prikladnaia Mekhanika*, vol. 8, Oct. 1972, p. 129-132. In Russian.

Determination of the efficiency of using the boundary layer as the working fluid in a ramjet engine in order to achieve high aircraft speeds. A comparison is made between a structure which uses the boundary layer as the working fluid and a structure which draws the working fluid into the nose section. Expressions are obtained for the external efficiency of both types of structures as a function of the boundary layer parameters and the flow rate. A.B.K.

A73-23395 * Airborne visible laser optical communication experiment. J. L. Randall (NASA, Marshall Space Flight Center, Astrionics Laboratory, Huntsville, Ala.). In: International Telemeter-

ing Conference, Los Angeles, Calif., October 10-12, 1972, Proceedings. Woodland Hills, Calif., International Foundation for Telemetering, 1972, p. 395-406.

A series of optical communication experiments between a high altitude aircraft at 18.3 km (60,000 ft) and a ground station are planned by NASA in the summer of 1972. The basic concept is that an optical tracker and transmitter will be located in each terminal. The aircraft transceiver consists of a 5-mW HeNe laser transmitter with a 30-megabit modulator. The ground station beacon is an argon laser operating at 488 nm. A separate pulsed laser radar is used for initial acquisition. The objective of the experiment is to obtain engineering data on the precision tracking and communication system performance at both terminals. Atmospheric effects on the system performance are of prime importance. (Author)

A73-23443 # Compressible unsteady interactions between blade rows. C. Osborne (Cornell University, Ithaca, N.Y.). *AIAA Journal*, vol. 11, Mar. 1973, p. 340-346. 21 refs. USAF-supported research.

The effects of compressibility on the unsteady forces generated by the aerodynamic interaction of blade rows in a jet engine are investigated. Both potential-flow interactions and viscous-wake interactions are treated, and the unsteady upwash distributions for these are found in a manner similar to the Kemp-Sears technique for the incompressible-flow problem. The unsteady forces are found from a recently developed theory (by the present author) in which the unsteady incompressible thin-airfoil theory of Sears was extended to the compressible case by using the Matched Asymptotic Expansions technique. The results for all the interactions indicate a significant decrease in the lift forces with increasing Mach number, M until $M = 0.9$ or so, where the results tend to blow up due to the Prandtl-Glauert stretching involved in deriving the unsteady subsonic thin-airfoil theory. (Author)

A73-23464 # Thermal conductivity of mixed-composition plasma-sprayed coatings. R. L. Newman and W. C. Spicer (General Motors Corp., Detroit Diesel Allison Div., Indianapolis, Ind.). *AIAA Journal*, vol. 11, Mar. 1973, p. 401-403. 5 refs.

Previously reported thermal conductivity data on plasma-sprayed mixed coatings, in general, and on multilayered graded coatings, in particular, are reviewed and amplified. The graded coatings minimize compositional discontinuity and prevent spalling through application of multilayered coatings varying in composition from 100% metal at the interface to 100% ceramic at the outer layer. Environmental tests of these graded thermal barriers have successfully demonstrated their ability to reduce heat transfer to coated turbine components and to survive the engine environment. M.V.E.

A73-23467 # Locus of a one-dimensional shock front caused by a disturbance moving on a circle. F. Meyer (Aerospace Corp., El Segundo, Calif.). *AIAA Journal*, vol. 11, Mar. 1973, p. 408, 409.

Batdorf (1972) concluded from geometric considerations that the shock front resulting from a disturbance traveling at constant supersonic speed around a circle is at any given time an involute of the sonic circle. This result has led to an improved technique for locating the shock front, in which direct plotting of the locus point by point is possible. F.R.L.

A73-23468 * # Estimation of aerodynamics for slender bodies alone and with lifting surfaces at α 's from 0 deg to 90 deg. L. H. Jorgensen (NASA, Ames Research Center, Moffett Field, Calif.). *AIAA Journal*, vol. 11, Mar. 1973, p. 409-412. 7 refs.

Expressions are derived, according to a method developed by the author (1972), for bodies in which the cross-sectional shape (but not necessarily the area) is constant along the longitudinal axis. For the more general case of a body alone or with lifting surfaces where the cross-sectional shape varies along the length, a similar procedure is suggested. The specific case for an elliptic cone with a triangular

wing is considered, and formulas for winged elliptic cross sections are developed. For the limited test conditions shown, the agreement between computed and experimental results is very good. F.R.L.

A73-23521 # Manufactured-in-house or subcontracted - Finding the economic balance. D. A. Lessware (SARMA, England). *Aircraft Engineering*, vol. 45, Feb. 1973, p. 4-8.

The example of a mechanical flight control strut is used to demonstrate technical, financial, and other commercial advantages which may be gained by an aircraft manufacturer in subcontracting the fabrication of certain specialized components. Arguments in favor of subcontracting are based on several factors of interest to management. These include structural efficiency; reliability; safety; costs in development, design, tooling, and production; administrative aspects; cash flow considerations; and manpower requirements. T.M.

A73-23522 # Resistant finishes. J. B. G. Lewin. *Aircraft Engineering*, vol. 45, Feb. 1973, p. 11, 12.

Aircraft surface primers and finishes designed to withstand severe environmental conditions are described in terms of composition, pretreatment, and application factors governing flexibility, adhesion, water resistance, hardness, and chemical stability. The properties of amine and polyamide cured epoxy primers are summarized along with important features of acrylic, epoxy, and polyurethane finishes. T.M.

A73-23525 # Ram air turbines. P. W. Morris (Dowty Rotol, Ltd., Gloucester, England). *Aircraft Engineering*, vol. 45, Feb. 1973, p. 24, 25, 30.

Description of the design, performance, and controls of a ram air turbine intended as an emergency power source on aircraft. The two-blade turbine described operates with a low pressure difference across the disk, passes a high mass flow, and is controlled by varying the blade pitch to give an incidence appropriate to the power demand and operating conditions. Curves show wind-tunnel performance characteristics, and the hydraulic system used for blade pitch control is explained. T.M.

A73-23599 # Influence of a change in the throughput of the power turbine on the parameters of a dual-shaft gas turbine engine (Vliianie izmeneniia propusknoi sposobnosti silovoi turbiny na parametry dvukhval'nogo gazoturbinogo dvigatelya). I. A. Barskii. *Mashinostroenie*, no. 11, 1972, p. 85-90. In Russian.

A73-23636 Radio navigation (Funknavigation). H. C. Freiesleben and J.-P. Hach (Deutsche Lufthansa AG, Hamburg, West Germany). *VDI-Z*, vol. 115, no. 3, Feb. 1973, p. 214-219. 91 refs. In German.

Various approaches for determining the position of a ship with the aid of a radio method are examined, giving attention to radar, the Omega navigation system, and Loran. Aspects of navigation with the aid of satellites are discussed together with inertial navigation methods, integrated navigation systems, area navigation, and landing systems. Approaches for providing protection against collision in the case of ships and aircraft are considered along with problems of navigation during space flights. G.R.

A73-23652 # MLS - On the beam for '76. J. W. Edwards (FAA, Washington, D.C.). *Astronautics and Aeronautics*, vol. 11, Mar. 1973, p. 24-30.

The standard VHF/UHF ILS is limited to a single approach path. Recognition of the deficiencies of the present system prompted the formation in December 1967 of Special Committee 117 (SC-117) to develop a precision guidance-system concept for approach and landing and an associated signal structure. SC-117 identified two techniques and signal formats as having the greatest potential for satisfying the requirements. The techniques include the conventional scanning beam and Doppler scanning. The recommendations fur-

nished the guidelines for the Microwave Landing System (MLS) development program. Details of the five-year development plan are discussed. G.R.

A73-23653 * # Door to door short haul. F. R. Steven (NASA, Washington, D.C.). *Astronautics and Aeronautics*, vol. 11, Mar. 1973, p. 32-44. 7 refs.

Present drawbacks to short-haul air transportation are partly related to passenger and baggage processing at air terminals and ground access difficulties. It is pointed out that the widely used automobile is the most inefficient mode of transportation. Various new developments in the field of ground transportation are considered. It is suggested to develop an integrated transportation system which would replace the various competing modes of automobile, bus, rail, and air with a single system for moving people and goods from their origins to their destinations. The Intermodal Automated Transfer system discussed would treat the passenger, his baggage, and the seat in which he travels as a unit which would stay together throughout a trip, regardless of the carrier used. G.R.

A73-23655 Development of maintenance policies in the operation of aircraft (Evolution des politiques de maintenance dans l'exploitation des matériels aériens). A. Mihail and G. Martin (Bureau Véritas, Paris, France). *L'Aéronautique et l'Astronautique*, Jan.-Feb. 1973, p. 21-31. In French.

A73-23656 Take-off and landing trajectography (Trajectographie de décollage et d'atterrissage). A. Klopstein (Centre de Documentation pour l'Armement, Paris, France) and C. Lefevre (Centre d'Essais en Vol, Brétigny-sur-Orge, Essonne; Centre de Documentation pour l'Armement, Paris, France). *L'Aéronautique et l'Astronautique*, Jan.-Feb. 1973, p. 32-43. In French.

The magnitudes and accuracies of takeoff and landing trajectories are discussed with reference to their applicability in the certification of aircraft. The certification of automotive approach systems and methods of short-distance trajectography are considered. Trajectography by cinetheodolites, a system of digital optical trajectography, an airborne system, and trajectography by an inertial and radiosonde system are described. F.R.L.

A73-23657 Remarks on the ISO international standards relating to 'Terms and Symbols for Flight Dynamics' (Commentaires sur les normes internationales ISO relatives aux 'Termes et Symboles de la mécanique du vol'). P. Rebuffet. *L'Aéronautique et l'Astronautique*, Jan.-Feb. 1973, p. 55-59. In French.

A73-23659 Air cushion landing gears for aircraft (Atterrisseurs d'avion à coussin d'air). G. Bruner and D. Laurent (Centre de Documentation pour l'Armement, Paris, France). *L'Aéronautique et l'Astronautique*, Jan.-Feb. 1973, p. 93-109. In French.

Following an exposition of the principle of air cushion landing gears and of the methods of forecasting the peripheral jet stream performance and the dynamical behavior of the device, a description of the system tested on a modified LA-4 and of the system to be installed on the 'Buffalo' STOL is given. In conclusion, the advantages offered by this new kind of landing gear - especially as regards the transport aircraft - are detailed. (Author)

A73-23662 # Helicopter main-rotor blade flutter in steady inclined flight (Flutter lopat wirnikow nosnych smiglowcow w ustalonym locie skosnym). L. Zerek. *Instytut Lotnictwa, Prace*, no. 52, 1972, p. 19-43. 7 refs. In Polish.

A73-23682 # Aircraft of the future (Flugzeuge der Zukunft). I. Tolztych. (*Grazhdanskaya Aviatsiya*, no. 6, 1972, p. 18, 19.) *Technisch-ökonomische Informationen der zivilen Luftfahrt*, vol. 8, no. 9, 1972, p. 419-424. In German. (Translation).

Evaluation of the technical and economic efficiency of types of aircraft likely to be developed in the coming decades. The problem

of evaluating the degree of structural maturity and perfection of passenger aircraft and their economic efficiency is discussed. Problems connected with the development of increasingly high-speed subsonic aircraft, supersonic, and, ultimately, hypersonic aircraft are discussed, including engine designs, fuels, and noise reduction. In addition, the use of VSTOLs to provide more efficient transportation between airports and city centers is considered. A.B.K.

A73-23683 # Duties and rights of the commander and crew on board civil aircraft - On the entry into effect of the order of the ministerial council of the German Democratic Republic of July 4, 1972 (Pflichten und Rechte des Kommandanten und der Besatzung an Bord ziviler Luftfahrzeuge - Zum Inkrafttreten der Verordnung des Ministerrates der Deutschen Demokratischen Republik vom 4. Juli 1972). K.-D. Günter and F. Schläfert (Ministerium für Verkehrswesen, Berlin, East Germany). *Technisch-ökonomische Informationen der zivilen Luftfahrt*, vol. 8, no. 9, 1972, p. 425-428. 9 refs. In German.

Concise summary of the political and legal significance of a recently promulgated document concerning measures to be taken by the commander and crew of a passenger aircraft to prevent or foil a hijacking attempt. The order in question grants the flight commander the right to carry out searches of passengers whose behavior arouses suspicion and to confiscate any items deemed incompatible with flight safety and, if necessary, to use force in carrying out these measures. A.B.K.

A73-23697 Flow through moving cascades of lifting lines with fluctuating lift. W. R. Hawthorne (Cambridge University, Cambridge, Mass.). *Journal of Mechanical Engineering Science*, vol. 15, Feb. 1973, p. 1-10. 8 refs.

The use of generalized functions to analyse the potential, two-dimensional, incompressible flow past singularities representing stationary and moving lifting lines is explained and developed. It is shown that the time mean stagnation pressure change in the flow through a moving cascade with fluctuating lift is normally zero, except when the lift fluctuations are in phase with the motion, so that a stationary system of shed vortices is produced in the downstream flow (the stationary, phased, fluctuating lift case). Then the time mean stagnation pressure is a function of position in the absolute co-ordinate system. Expressions are obtained for the kinetic energy produced by the vortices shed off a row of blades with fluctuating lift. (Author)

A73-23759 # The designer's view of aircraft maintenance. S. C. Calendi (Hawker Siddeley Aviation, Ltd., Hatfield, Herts., England). (*British Air Line Pilots Association, Technical Symposium on the Outlook on Safety*, 13th, London, England, Nov. 14-16, 1972.) *Tech Air*, vol. 29, Mar. 1973, p. 6-13.

The interrelationship between aircraft maintenance and safety as viewed by the aircraft designer is reviewed. The high safety standard presently demanded may only be achieved if great attention is given to maintenance procedures and these are considered in detail during the design stage. The object of aircraft maintenance is to prevent deterioration of the inherent safety and reliability levels of the equipment and, if possible, to increase these levels by modification action as deficiencies are recognized during the operation of the aircraft. Aspects of human error, fault diagnosis, redundancy, maintenance analysis, service data, and equipment specification are discussed. F.R.L.

A73-23762 Comparison of conventional flight control systems with a modern integrated flight control system (Vergleich konventioneller Flugregelungssysteme mit einem modernen integrierten Flugregelungssystem). G. Schänzer (Bodenseewerk Gerätetechnik GmbH, Überlingen, West Germany). *Flug Revue/Flugwelt International*, Mar. 1973, p. 25-30. In German.

A73-23774 # Productivity estimates of the strategic airlift system by the use of simulation. R. L. Nolan (Harvard University, Cambridge, Mass.) and R. Mastroberti (Anne Arundel Community College, Annapolis, Md.). *Naval Research Logistics Quarterly*, vol. 19, Dec. 1972, p. 737-752. 8 refs.

An analysis of the strategic airlift system productivity function, using a large-scale simulation model, is described. The experimental design developed for the analysis consisted of full factorial design sets for a finite number of factors. This design made possible the overlapping of simulation runs to fill out the factorial design sets. In addition to estimating the airlift productivity function, several other findings are reported which tend to disprove previous assumptions about the nature of the strategic airlift system. M.V.E.

A73-23775 # A probabilistic evaluation of helicopter lift capability. D. R. Limaye and E. Levy (Decision Sciences Corp., Jenkintown, Pa.). *Naval Research Logistics Quarterly*, vol. 19, Dec. 1972, p. 761-775. 8 refs.

This paper describes a technique for the calculation of the probability that a helicopter can lift a specified load, or number of loads with a specified frequency distribution, in a given geographical region. This probability is computed by determining the bivariate altitude-temperature probability distribution for the specified region. The payload capability at any given temperature and altitude is calculated from standard performance equations. By integrating this over the altitude-temperature distribution, it is possible to obtain the probability distribution of payload capability, from which the required probabilities of lifting specific loads can be determined. (Author)

A73-23784 Precision hover sensor for heavy-lift helicopter. D. G. Herzog (RCA Advanced Technology Laboratories, Camden, N.J.). In: *RCA advanced technology*. Moorestown, N.J., Radio Corporation of America, 1972, p. 16-21.

A helicopter stabilization system under development uses two newly developed sensor techniques - image-correlation tracking and pulsed sine-modulated laser ranging - which are combined with the best all-weather, day-night, pulsed-laser-illuminated gated imaging to measure position offsets and velocities using arbitrary scene references. Positional offsets can be measured in three dimensions to 0.6 in., and velocities as low as 1 in./sec at distances of 125 ft. The stabilization system is designed to freeze the helicopter in mid-air over a designated cargo handling position even under wind gusts of 45 knots and in dusty environments. (Author)

A73-23799 # Optimization and design of the rear fuselage of the A 300 B aircraft structure. D. Schulz (Messerschmitt-Bölkow-Blohm GmbH, Hamburg, West Germany). *NATO, AGARD, Symposium on Structural Optimization*, 2nd, Milan, Italy, Apr. 2-4, 1973, Preprint. 15 p.

This report gives a description of a method for the automatically controlled calculation of a skin/stringer structure developed by MBB-UH. The method was programmed and applied for the first time for the development of the Airbus A 300 B. Input and output data for the calculations of statically indeterminate forces are used as input data for structure dimensioning or strength analysis program. The structure dimensioning program iteratively modifies the originally defined wall thicknesses so that the reserve factors required to prevent failure under tensile, compression and shear loads are reached or only slightly exceeded in all critical load cases. The originally defined structural concept (stringer and frame spacing as well as stringer shapes) is not changed in this case. Final dimensioning is influenced by manufacturing considerations. On completion of the dimensioning work the dimensions are laid down and the strength analysis is carried out in a single computer run. (Author)

A73-23851 Annual review of fluid mechanics. Volume 5. Edited by M. Van Dyke and W. G. Vincenti (Stanford University,

Stanford, Calif.). Palo Alto, Calif., Annual Reviews, Inc., 1973. 453 p. \$10.00.

Longitudinal dispersion and turbulent mixing in open-channel flow, mathematical aspects of Prandtl's boundary-layer theory, and intermittency in large-scale turbulent flows are among the topics covered in papers concerned with fluid mechanics. Attention is given to the use of lasers for local measurement of velocity components, species densities, and temperatures; instability, transition, and turbulence in buoyancy-induced flows; and recent developments in the theory, experiment, and design of transonic airfoils.

M.V.E.

A73-23856 Transonic airfoils - Recent developments in theory, experiment, and design. G. Y. Nieuwland (Vrije Universiteit, Amsterdam, Netherlands) and B. M. Spee (Nationaal Luchtvaartlaboratorium, Amsterdam, Netherlands). In: Annual review of fluid mechanics. Volume 5. Palo Alto, Calif., Annual Reviews, Inc., 1973, p. 119-150. 61 refs.

A73-23860 * Secondary flows - Theory, experiment, and application in turbomachinery aerodynamics. J. H. Horlock (Cambridge University, Cambridge, England) and B. Lakshminarayana (Pennsylvania State University, Philadelphia, Pa.). In: Annual review of fluid mechanics. Volume 5. Palo Alto, Calif., Annual Reviews, Inc., 1973, p. 247-280. 50 refs. Grant No. NGL-39-009-007.

A73-23861 Noise from aircraft turbomachinery. J. E. McCune and J. L. Kerrebrock (MIT, Cambridge, Mass.). In: Annual review of fluid mechanics. Volume 5. Palo Alto, Calif., Annual Reviews, Inc., 1973, p. 281-300. 32 refs.

Review of recent research on supersonic jet noise due to turbomachinery, with special attention to the connection between noise production and performance measured in terms of thrust per unit of airflow and thrust per unit of engine weight. It is shown that the possibilities of noise abatement offered by reduction of the thrust per unit of airflow, as opposed to more direct noise-reduction techniques, such as duct treatment, and particularly jet suppressors, may as yet not have been fully appreciated.

M.V.E.

A73-23862 * Mixing-controlled supersonic combustion. A. Ferri (New York University, Bronx, N.Y.). In: Annual review of fluid mechanics. Volume 5. Palo Alto, Calif., Annual Reviews, Inc., 1973, p. 301-338. 57 refs. Grant No. NGR-33-016-131.

The technology of supersonic combustion and its practical significance for hypersonic flight are reviewed. It is shown that this technology makes possible a good qualitative and quantitative understanding of the physical phenomena related to the process of supersonic combustion. Some of the more important, summarized aspects of this technology include the physical description of the supersonic combustion flame, the chemical reaction rates and the diffusion process involved, the interaction between combustion and fluid dynamics, and the mathematical methods of supersonic combustion analysis.

M.V.E.

A73-23950 Improving reliability and eliminating maintenance with elastomeric dampers for rotor systems. J. L. Potter (Lord Manufacturing Co., Erie, Pa.). *American Helicopter Society, Journal*, vol. 18, Jan. 1973, p. 23-28.

Elastomeric dampers are a new generation of dampers designed to prevent helicopter and/or VTOL rotor system instability. The damper employs a highly damped viscoelastic polymer, vulcanized and bonded to metallic members which in turn are connected to the rotor system. Deformation of the viscoelastic material produces a total resisting force composed of a damping and an elastic component operating 90 deg out of phase due to the hysteresis inherent in the polymer. The damper service life can be in the range of 1500-2000 flight hours with no maintenance or lubrication required.

(Author)

A73-23964 Ballistic-tolerant helicopter flight control components from plastic composite materials. L. A. Fry (U.S. Army, Air Mobility Research and Development Laboratory, Fort Eustis, Va.), R. L. Van Auker, and V. A. Chase (Whittaker Corp., San Diego, Calif.). In: Reinforced plastics - Ever new; Proceedings of the Twenty-eighth Annual Conference, Washington, D.C., February 6-9, 1973. New York, Society of the Plastics Industry, Inc., 1973, p. 12-A,1 to 12-A,6.

The high vulnerability of present-day helicopter flight systems to ballistic damage from small arms fire has led to the investigation of new materials and design concepts to effectively reduce the damage incurred by a ballistic hit. A solution for the catastrophic failure incurred in the present metal hardware has been found in the development of lightweight flight control components made from fiberglass-reinforced composite materials. The ability to incorporate multiloading paths reduces ballistic vulnerability, therefore improving aircraft survivability. The success of the initial developments has led to the investigation of low cost, high volume production methods to produce flight control component systems from fiberglass-reinforced composite material to replace the vulnerable metal components.

(Author)

A73-23969 Feasibility evaluation of graphite/epoxy composite materials to helicopter transmission housing. V. A. Chase, R. L. Van Auker (Whittaker Corp., San Diego, Calif.), and R. L. Rodgers (U.S. Army, Air Mobility Research and Development Laboratory, Fort Eustis, Va.). In: Reinforced plastics - Ever new; Proceedings of the Twenty-eighth Annual Conference, Washington, D.C., February 6-9, 1973. New York, Society of the Plastics Industry, Inc., 1973, p. 15-B,1 to 15-B,8.

A73-23989 * # Intensive probing of a clear air convective field by radar and instrumental drone aircraft. J. R. Rowland (Johns Hopkins University, Silver Spring, Md.). *Journal of Applied Meteorology*, vol. 12, Feb. 1973, p. 149-155. 18 refs. USAF-NASA-supported research.

An instrumented drone aircraft was used in conjunction with ultrasensitive radar to study the development of a convective field in the clear air. Radar data are presented which show an initial constant growth rate in the height of the convective field of 3.8 m/min, followed by a short period marked by condensation and rapid growth at a rate in excess of 6.1 m/min. Drone aircraft soundings show general features of a convective field including progressive lifting of the inversion at the top of the convection and a cooling of the air at the top of the field. Calculations of vertical heat flux as a function of time and altitude during the early stages of convection show a linear decrease in heat flux with altitude to near the top of the convective field and a negative heat flux at the top. Evidence is presented which supports previous observations that convective cells overshoot their neutral buoyancy level into a region where they are cool and moist compared to their surroundings. Furthermore, only that portion of the convective cell that has overshoot its neutral buoyancy level is generally visible to the radar.

(Author)

A73-23991 # A method for correcting airborne temperature data for sensor response time. J. McCarthy (Chicago, University, Chicago, Ill.). *Journal of Applied Meteorology*, vol. 12, Feb. 1973, p. 211-214. NSF Grant No. GA-28190X1.

Equations are developed which describe (1) the airborne temperature instrumentation response to an arbitrary ambient temperature profile, for a two-term exponential system; and (2) a numerical scheme which corrects the sensor data for this lag. When in-cloud temperature fluctuations are of the same order as the instrument fidelity, as in some cumulus cloud penetrations, serious discrepancies may result between the ambient profile and the sensor response, making a correction desirable.

(Author)

A73-24001 International Federation of Automatic Control, World Congress, 5th, Paris, France, June 12-17, 1972, Proceedings. Part 2 - Transportation, aeronautics and space, ship

automation, and control components: Part 3 - Ecology and systems engineering; Large scale, sensitivity, optimization and adaptation theory. Part 4 - Education, feedback, regulators, linear and nonlinear systems; Identification, differential games, discrete and stochastic systems. Congress co-sponsored by the Union of International Engineering Organizations. Düsseldorf, International Federation of Automatic Control, 1972. Pt. 2, 404 p.; pt. 3, 488 p.; pt. 4, 457 p. Price of each part, \$35.

New methods for synthesis and analysis of automatic control systems are described in papers dealing with applications in surface transport, aerospace vehicles, data handling, industrial process control, management of large-scale socioeconomic systems, and education. Topics considered include urban traffic control, spacecraft stabilization and guidance, computer simulation of legged locomotion systems, aircraft flight control systems, transducer designs for control applications, stepping-motor characteristics, environmental management, biological control systems, national and regional economic systems, and management of industrial concerns. Extensive theoretical material is covered in areas of system optimization, sensitivity, adaptive control, estimation, identification, differential games, and discrete automata.

T.M.

A73-24009 **Theoretical and practical aspects of an automatic hover control system for an unmanned tethered rotorplatform.** G. Schmidt and R. Swik (Dornier AG, Friedrichshafen, West Germany). In: International Federation of Automatic Control, World Congress, 5th, Paris, France, June 12-17, 1972, Proceedings. Part 2. Düsseldorf, International Federation of Automatic Control, 1972, p. 19.1.1-19.1.8. 5 refs.

A73-24010 **Automatic landing as a terminal control problem.** Iu. P. Gus'kov. In: International Federation of Automatic Control, World Congress, 5th, Paris, France, June 12-17, 1972, Proceedings. Part 2. Düsseldorf, International Federation of Automatic Control, 1972, p. 19.2.1-19.2.6.

Consideration of the synthesis of an efficient and simple law for a feedback-based control to implement the automation of aircraft landing maneuvers. The selection of the landing control law is based on the trajectory-termination or terminal-control requirements for a desirable aircraft contact with the ground at touchdown. The approach to the synthesis problem is characterized by introduction of terminal control discreteness into the feedback.

M.V.E.

A73-24011 * **A control theoretic model for piloted approach to landing.** D. L. Kleinman and S. Baron (Bolt Beranek and Newman, Inc., Cambridge, Mass.). In: International Federation of Automatic Control, World Congress, 5th, Paris, France, June 12-17, 1972, Proceedings. Part 2. Düsseldorf, International Federation of Automatic Control, 1972, p. 19.3.1-19.3.8. 10 refs. Contract No. NAS2-5962.

Using manned vehicle systems analysis, a model for manual approach to landing is developed. This model is developed and applied in the specific context of a problem of analytical evaluation of a pictorial display for longitudinal control of glide path errors. This makes it possible to discuss the model in concrete terms, and the availability of experimental data provides opportunities for checking the theoretical results obtained.

M.V.E.

A73-24012 **Dynamics of variable sweep wing aircraft in the course of changing geometry.** V. P. Bulekov and E. D. Teriaev. In: International Federation of Automatic Control, World Congress, 5th, Paris, France, June 12-17, 1972, Proceedings. Part 2. Düsseldorf, International Federation of Automatic Control, 1972, p. 19.5.1-19.5.10.

It is the purpose of this paper to investigate the dynamics of variable sweep wings aircraft in the course of changing geometry. It is proposed the mathematical techniques based on the pulse reaction to use for the analysis of the equations with time varying coefficients

which describes apparatuses in the regime of the geometry change. It is investigated the possibility of decreasing the time of the geometry change.

(Author)

A73-24092 # **Contribution to the bonding of glass laminates and metals (Prispevek ke spojovani skelných laminátů s kovy).** J. Kobes. In: Intermetalbond '72; Conference on the Bonding of Metals, 5th, Boboty, Czechoslovakia, November 21-23, 1972, Proceedings. Bratislava, Dom Techniky SVTS, 1972, p. 62-73, 75. In Czech.

Review of certain differences between metal/glass laminate bonding and metal/metal bonding, and evaluation of tests of various bonding materials for use in metal/glass laminate bonding. It is stressed that the decisive factor affecting the strength of a glass laminate bonded joint, assuming that an appropriate surface finish has been attained and that a high-quality bonding material is being used, is the interlaminar strength of the glass laminate. By increasing the interlaminar strength, the strength of the bonded joint can be increased.

A.B.K.

A73-24165 **Investigation of iron content of lubricating oil using a ferrophotograph and an emission spectrometer.** V. C. Westcott and W. W. Seifert (Trans-Sonics, Inc., Burlington, Mass.). *Wear*, vol. 23, Feb. 1973, p. 239-249. Contract No. N00014-72-C-0278.

An investigation was carried out into the discrepancies in iron content of used oils as assessed by density readings of Ferrograms and determined by several emission spectrometers of the rotating disk type. It was concluded that used jet engine oil contains a significant number of iron particles so large that the spectrometer is not responsive to them and also contains a large total fraction of iron content in the form of nonmagnetic compounds which are not precipitated on the Ferrogram.

(Author)

A73-24363 # **Calculation of the contact rigidity of cylindrical joints (O vychíslení kontaktní zhybkosti tsilindricheskikh soedineníí).** A. B. Milov (Rizhskii Institut Grazhdanskoi Aviatcii, Riga, Latvian SSR). *Problemy Prochnosti*, vol. 5, Jan. 1973, p. 70-72. 8 refs. In Russian.

Relations for calculating elastic strains in overlapping joints of cylindrical tubes are derived on the basis of Shtaerman's (1949) analysis in which the plane contact problem is reduced to the solution of an integrodifferential equation of the type of Prandtl's equation in the theory of a wing of finite span. The solution of this equation is simplified by approximating the law describing the pressure distribution over the arc of contact.

V.P.

A73-24386 # **Influence of the nonidentity of the antennas of a Doppler speed meter on the accuracy of its operation (Vliianie neidentichnosti antenn dopplerovskogo izmeritel'ia skorosti na tochnost' ego raboty).** V. I. Baburin, L. N. Zakhar'ev, and A. A. Lemanskii. *Radiotekhnika*, vol. 27, Dec. 1972, p. 94-96. In Russian.

A73-24391 * **Scaling aircraft noise perception.** J. B. Ollerhead (Loughborough University of Technology, Loughborough, Leics., England). *Journal of Sound and Vibration*, vol. 26, Feb. 8, 1973, p. 361-388. 26 refs. FAA-NASA-supported research.

Following a brief review of the background to the study, an extensive experiment is described which was undertaken to assess the practical differences between numerous alternative methods for calculating the perceived levels of individual aircraft flyover sounds. One hundred and twenty recorded sounds, including jets, turboprops, piston aircraft and helicopters were rated by a panel of subjects in a pair comparison test. The results were analyzed to evaluate a number of noise rating procedures, in terms of their ability to accurately estimate both relative and absolute perceived noise levels over a wider dynamic range (84-115 dB SPL) than had generally been used in previous experiments. Performances of the

different scales were examined in detail for different aircraft categories, and the merits of different band level summation procedures, frequency weighting functions, duration and tone corrections were investigated. (Author)

A73-24474 Will this be the Aeritalia-Boeing (Sarà questo il Boeing-Aeritalia). P. L. Guida. *Aviazione di Linea, Difesa, e Spazio*, vol. 11, Feb. 1973, p. 32-34. In Italian.

Review of the probable design features of the 7X7 passenger aircraft being built as part of a project involving a family of three vehicles for short, medium, and long hauls. The QSH - quiet short haul - represents the aircraft of the original Aeritalia-Boeing agreement. From this, medium- and long-range versions have been derived. The 7X7 is to have a low wing and T tail - a fairly conventional configuration, were it not for the wing-mounted engines installed in this way for noise suppression. The capacity of the 7X7 will range from 180 to 200 passengers, and very likely more in the long-haul version. It is still not certain what the number of propulsion units will be. The final result could be either two engines in the short- and medium-haul versions and three in the long-range version, or possibly three and four engines, respectively. A.B.K.

A73-24475 Visibility zero even for helicopters (Visibilità zero anche per gli elicotteri). P. Marini. *Aviazione di Linea, Difesa, e Spazio*, vol. 11, Feb. 1973, p. 66, 67. In Italian.

Description of a Doppler navigation system for helicopters which obtains data through a computer display method. The system in question is called TANS (Tactical Air Navigation System). The computer involved uses completely autonomous navigation sensors and is capable of providing not only a representation of cartographic data (indicating the position of the aircraft on a strip of cartographic paper) but also an entire gamut of essential information. A.B.K.

A73-24494 A method of measuring the thrust, the polar, and the performance of an aircraft on the basis of flight tests (Metodo per la misura della spinta, della polare e delle prestazioni di un aeromobile con prove di volo). M. Cassetti (Genio Aeronautico, Rome, Italy). *L'Aerotecnica - Missili e Spazio*, vol. 51, Dec. 1972, p. 375-380. In Italian.

A73-24542 Solving flight-path optimization problems on a minicomputer. F. Y. Thomasson (Babcock and Wilcox Co., Lynchburg, Va.) and G. Cook (Virginia, University, Charlottesville, Va.). *Astronautica Acta*, vol. 18, Feb. 1973, p. 45-51. Research sponsored by Teledyne.

The problem of determining maximum-range flight paths for a jet transport during climb is investigated. The objective is to guide the aircraft so that it will reach a prespecified cruise altitude and velocity and obtain maximum range in the process. The amount of fuel to be used is prespecified. Motion is in a vertical plane with lift coefficient being the control variable. The system of differential equations describing the motion of the plane is fifth order and nonlinear. The conjugate gradient procedure is used to solve the problem. The complexity is such that 36,000 storage locations are required for the most straightforward application of the procedure. Through various approximations this requirement is reduced to 250 locations. Simulations showed that performance is not degraded through the approximations. The magnitude of the problem is thus reduced to that which could be solved by an onboard minicomputer. This is a major step toward the realization of optimal feedback control. The other requirement is that computation time be short enough to permit on-line solutions. (Author)

A73-24551 EASCON '72; Electronics and Aerospace Systems Convention, Washington, D.C., October 16-18, 1972, Record. Convention sponsored by the Institute of Electrical and Electronics Engineers. New York, Institute of Electrical and Electronics Engineers, Inc., 1972. 200 p. Members, \$12.50; nonmembers, \$14.50.

Aerospace and environmental studies consider aircraft noise and pollution reduction, safety, operations, and future systems. Aspects of energy demand and supply are treated, and a systems approach to anti-hijacking is presented. Complex target resolution with the random signal radar, and the evolution of commercial satellite communications systems are examined. Deficits in visual functions associated with laser irradiation are discussed.

F.R.L.

A73-24552 The DOT/NASA Civil Aviation Research and Development Policy Study. A. B. Linhares (U.S. Department of Transportation, Washington, D.C.). In: EASCON '72; Electronics and Aerospace Systems Convention, Washington, D.C., October 16-18, 1972, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1972, p. 10-15.

The Civil Aviation Research and Development (CARD) Policy Study was undertaken jointly by the Department of Transportation and the National Aeronautics and Space Administration in response to a recommendation by the Senate Committee on Aeronautical and Space Sciences (90th Congress). The Study evolved as a comprehensive review of policies affecting civil aviation, of the problems confronting it, and of the potential it possesses for future contributions to the Nation. The priority areas identified for R&D were environmental problems (noise and pollution), congestion, and low-density short-haul service and economics. The importance of long-haul aircraft R&D was also addressed. Significant actions which have been taken as a result of the study are also described. (Author)

A73-24553 Aircraft noise abatement. C. R. Foster (U.S. Department of Transportation, Washington, D.C.). In: EASCON '72; Electronics and Aerospace Systems Convention, Washington, D.C., October 16-18, 1972, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1972, p. 16-21.

The problem of aircraft noise and the individual noise sources are identified. The programs within the Federal Government addressing aircraft noise abatement are delineated. The technology and its application for aircraft noise suppression as well as aircraft noise certification standards are presented. Pertinent federal laws and regulations pertaining to aircraft noise control are reviewed. (Author)

A73-24555 * Jet aircraft engine noise reduction. E. W. Conrad and C. C. Ciepluch (NASA, Lewis Research Center, Cleveland, Ohio). In: EASCON '72; Electronics and Aerospace Systems Convention, Washington, D.C., October 16-18, 1972, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1972, p. 50-55.

The major noise sources are considered together with the noise generation mechanisms involved and approaches for reducing or suppressing the generated noise. Important basic advances in engine noise reduction technology were made in connection with the NASA Quiet Engine program. The prospect for reducing the noise levels of future aircraft below that of the new wide-body jets is good. However, a significant penalty in the form of increased cost to the traveler is also to be expected as the aircraft noise levels are gradually decreased. G.R.

A73-24556 * Aircraft engine pollution reduction. R. A. Rudey (NASA, Lewis Research Center, Cleveland, Ohio). In: EASCON '72; Electronics and Aerospace Systems Convention, Washington, D.C., October 16-18, 1972, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1972, p. 56-63. 9 refs.

The effect of engine operation on the types and levels of the major aircraft engine pollutants is described and the major factors governing the formation of these pollutants during the burning of hydrocarbon fuel are discussed. Methods which are being explored to reduce these pollutants are discussed and their application to several experimental research programs are pointed out. Results showing

significant reductions in the levels of carbon monoxide, unburned hydrocarbons, and oxides of nitrogen obtained from experimental combustion research programs are presented and discussed to point out potential application to aircraft engines. An experimental program designed to develop and demonstrate these and other advanced, low pollution combustor design methods is described. Results that have been obtained to date indicate considerable promise for reducing advanced engine exhaust pollutants to levels significantly below current engines. (Author)

A73-24557 Aircraft wake vortex avoidance systems. M. Gorstein, J. Hallock, and I. McWilliams (Transportation Systems Center, Cambridge, Mass.). In: EASCON '72; Electronics and Aerospace Systems Convention, Washington, D.C., October 16-18, 1972, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1972, p. 64-69. 10 refs.

The functions performed by a wake vortex avoidance system include the detection or prediction of the current locus of the vortices in the air corridors near an airport and an indication of the hazard to a following aircraft. The characteristics of the vortices connected with the aircraft wake are considered together with the sensors required to detect these vortices. Two preliminary designs for wake vortex avoidance systems are discussed. The designs are based upon the current assessment of the aircraft-vortex hazards. In order to establish the system coverage requirements for the wake vortex avoidance system, a computer simulation has been developed of the transport of vortices in the terminal environment. G.R.

A73-24558 Aircraft initiation of lightning strikes. J. F. Shaeffer and G. L. Weinstock (McDonnell Aircraft Co., St. Louis, Mo.). In: EASCON '72; Electronics and Aerospace Systems Convention, Washington, D.C., October 16-18, 1972, Record.

New York, Institute of Electrical and Electronics Engineers, Inc., 1972, p. 70-76. 14 refs. Contract No. F33615-71-C-1581.

Analytical results and lightning simulation testing show that an aircraft can trigger lightning when flying in a highly charged atmospheric environment. For such an environment, the electric field intensification of the aircraft is high enough to initiate lightning which may not have occurred naturally. It is shown that an external source of charge is required to support an aircraft initiated discharge. The electric fields surrounding an F-4 and B-52 aircraft were determined from the electrostatic integral field equations using an algorithm which included actual aircraft geometry, an external cloud electric field, and a net charge on the aircraft. Capacitance of the aircraft was determined, and consequently the charged vehicle potential and electrostatic field energy were obtained. The algorithm has also been used to obtain the maximum net charge an F-4 and B-52 aircraft can hold before self discharge corona begins. The effect on these parameters caused by varying aircraft size is discussed. A brief background of lightning phenomena is presented including cloud environments, wave forms, and breakdown. (Author)

A73-24559 Transportation safety - Technology applications: A systems approach to anti-hijacking. M. Lauriente (U.S. Department of Transportation, Washington, D.C.). In: EASCON '72; Electronics and Aerospace Systems Convention, Washington, D.C., October 16-18, 1972, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1972, p. 77-80.

The elements of a total systems concept are offered as a solution to the hijack problem. The analysis considers evaluation of the threat, environments, and technology available. The goal is to achieve security with minimal interference with the high density passenger traffic. The purpose of this paper is to examine the United States Civil aviation security program, highlighting the anti-hijacking effort from a systems research and development point of view. It is hoped, in this way, to focus attention on what has been done and, especially, to draw attention to the needs now and in the future. (Author)

A73-24562 * Community response to aircraft noise. R. P. Whitten (NASA, Washington, D.C.). In: EASCON '72; Electronics and Aerospace Systems Convention, Washington, D.C., October 16-18, 1972, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1972, p. 180-183. 8 refs.

Organized community resistance to any plan of airport development has become so intense that noise exposure is a primary consideration in plans for new airports, runway extensions, and the introduction of new types of aircraft. Approaches for evaluating the amount of aircraft noise and the annoyance produced by it are discussed. The sociometric studies considered show that fear of crash is the strongest single variable. G.R.

A73-24631 A mechanized eddy current scanning system for aircraft struts. C. R. Reeves (Lockheed-Georgia Co., Marietta, Ga.). *American Society for Nondestructive Testing, National Fall Conference, Cleveland, Ohio, Oct. 16-19, 1972.* *Materials Evaluation*, vol. 31, Mar. 1973, p. 48-52.

Description of the design and operation of a mechanized eddy current defect detection system used for scanning internal cylindrical surfaces. The single coil scanning apparatus traces a helical path. Cracks as small as 0.050 in. (1.27 mm) long by 0.020 in. (0.508 mm) deep can be reliably detected at scan rates up to 140 sq. in. (910 sq. cm) per minute. A unique electronic, audio/visual indicator is incorporated into the portable eddy current inspection system to provide recognizable defect indications at high speeds. A description of two specific applications on aircraft landing gear components is presented with data on operating parameters. A number of potential uses for this system are also discussed. (Author)

A73-24646 Adrift on the air ocean - The future of air commerce /61st Wilbur and Orville Wright Memorial Lecture/. S. D. Browne. *Aeronautical Journal*, vol. 77, Feb. 1973, p. 69-73.

The air transport system is discussed, taking into account all aspects from manufacturers, to carriers, passengers, shippers and governments. Particular attention is given to the future of mass transport, the international rates and fares problem, the international exchange of rights, questions of security, and the future of technology. The problem of continual progress has to be solved without polluting the environment. G.R.

A73-24647 A new look at parachute opening dynamics. P. R. Payne. *Aeronautical Journal*, vol. 77, Feb. 1973; p. 85-93. 20 refs. Contract No. F33615-70-C-1420.

An analysis is conducted as a basis for the development of a very simplified model of parachute opening from first principles, without any appeal to experimental measurements. It is found that risers, shroud and canopy cloth stiffness have a major effect on opening history and loads. Transient phenomena occur at much higher frequencies than that associated with the total opening cycle. The line stretch existing at commencement of opening has a major influence on opening time and loads. G.R.

A73-24650 Selling high cost capital equipment. H. B. Cundall (Rolls-Royce, Ltd., Derby, England). *Aeronautical Journal*, vol. 77, Feb. 1973, p. 107-119. 16 refs.

A reasoned analysis is provided of the tasks, the functions, and the organization of a sales team. The marketing objectives are discussed together with the problems involved in launching a new product, the sales campaign, and the sales costs. General sales considerations are investigated, giving attention to nontechnical factors affecting sales, the understanding of business ethics, aspects of selling in the U.S., the Common Market effect on sales activities, and the national involvement in sales. G.R.

A73-24671 # Some control problems for centrifugal blowers (Nekotorye voprosy regulirovaniia tsentrobezhnykh dut'evykh mashin). S. P. Livshits. *Energomashinostroenie*, vol. 19, Jan. 1973, p.

12-14. In Russian.

Analysis of the effectiveness of flow twisting in front of the rotor as a control technique in centrifugal blower operation. Formulas are given to relate various parameters of the equipment and flow in centrifugal blowing processes with and without flow twisting. Criteria are proposed for the efficiency of centrifugal blowers. V.Z.

A73-24707 Human threats to air safety; Proceedings of the Twenty-fifth Annual International Air Safety Seminar, Washington, D.C., October 16-18, 1972. Seminar sponsored by the Flight Safety Foundation. Arlington, Va., Flight Safety Foundation, Inc., 1972. 227 p. \$10.00.

Criminal threats to safety in air transport are discussed with reference to hijacking, piracy and extortion, sabotage, explosive containment, and preventive measures taken by airlines. Human factors involving personnel, passengers, design of equipment, airport design and operation, and ground damage are considered. Search, rescue, and survival systems are evaluated. Safety research and development concerning lightning, fire detection, refueling, and turbine rotor blade or disk burst are studied. Attention is given to pilot incapacitation.

F.R.L.

A73-24708 # An international review of civil aircraft damaged or destroyed by deliberate detonation of explosives /sabotage/ 1964-1972. E. Newton (Department of Trade and Industry, Accident Investigation Branch, London, England). In: Human threats to air safety; Proceedings of the Twenty-Fifth Annual International Air Safety Seminar, Washington, D.C., October 16-18, 1972. Arlington, Va., Flight Safety Foundation, Inc., 1972, p. 35-42.

A73-24710 # Risk management, system safety and ground test programs. G. Sim (Lockheed-California Co., Burbank, Calif.). In: Human threats to air safety; Proceedings of the Twenty-fifth Annual International Air Safety Seminar, Washington, D.C., October 16-18, 1972. Arlington, Va., Flight Safety Foundation, Inc., 1972, p. 101-122. 10 refs.

Some of the risks associated with today's advanced flying systems are examined, and it is shown how some recent advances in ground testing philosophy and techniques will contribute to enhanced safety in the coming generation of new airline equipment. The Visual Systems Simulator (VSS) for the TriStar is briefly described. Its planned purposes are to provide a tool for systems development, permit systems environmental testing, provide systems endurance cycling evaluation, assist in FAA certification, provide early maintainability and reliability data, and provide a permanent facility for systems support. Attention is given to the Avionic Flight Control System (AFCS).

F.R.L.

A73-24712 # Significant elements of an effective search, rescue, and survival system. G. W. Heath (SAR-ASSIST, Inc., Greenwich, Conn.). In: Human threats to air safety; Proceedings of the Twenty-fifth Annual International Air Safety Seminar, Washington, D.C., October 16-18, 1972. Arlington, Va., Flight Safety Foundation, Inc., 1972, p. 137-147.

An attempt is made to question what may be the significant elements of a rescue system with the intent that the whole subject receive the benefit of rethinking. Attention is given to equipment design, role allocation between survivor and rescue team, and to the regulatory philosophy and specific requirements to which design, selection, and carriage of equipment necessarily must respond. Some future steps to improve performance are suggested.

F.R.L.

A73-24713 # Deficient airfields - Still today's problem-child. M. G. Williams (Court Line Aviation, Ltd., London, England). In: Human threats to air safety; Proceedings of the Twenty-fifth Annual

International Air Safety Seminar, Washington, D.C., October 16-18, 1972. Arlington, Va., Flight Safety Foundation, Inc., 1972, p. 150-154.

A satisfactory airfield must have runways of adequate length and strength for the proposed traffic with no obstructions within the approach and takeoff paths. The runways must be adequately drained, and preferably should be grooved to aid drainage and assist braking. The worst deficiency in any airfield is the lack of glide slope information, especially at night. The next major problem is the lack of static-free radio aids. It is suggested that the best cure for deficient airfields is strong government legislation. Another cure would be concerted action by the aircraft operators themselves.

F.R.L.

A73-24714 # Influence of airport design and management on ground damage to aircraft. C. W. Pace, Jr. (FAA, Airports Service, Washington, D.C.). In: Human threats to air safety; Proceedings of the Twenty-fifth Annual International Air Safety Seminar, Washington, D.C., October 16-18, 1972. Arlington, Va., Flight Safety Foundation, Inc., 1972, p. 155-162.

FAA Rule FAR Part 139 requires that each airport serving CAB-certificated air carriers meets prescribed minimum safety standards. These standards are examined to show how each will improve airport safety levels. The rules are concerned with pavement and safety areas, marking and lighting, fire fighting and rescue services, NavAids, airport condition assessment and reporting, fueling arrangements, and many other aspects. Steps being taken by the FAA to correct the deficiencies are discussed.

F.R.L.

A73-24715 # Air carrier ground damage - Typical incidents and patterns. E. B. Perry (Flight Safety Foundation, Inc., Arlington, Va.). In: Human threats to air safety; Proceedings of the Twenty-fifth Annual International Air Safety Seminar, Washington, D.C., October 16-18, 1972. Arlington, Va., Flight Safety Foundation, Inc., 1972, p. 170-179.

A few examples of damage to aircraft on the ground are described, and the cost of repairs and out-of-service time that results from these mishaps is discussed. In addition to the cost of aircraft damage, damage to ground equipment is expensive to repair and operations suffer when that equipment is out of service. An attempt is made to combine some common information from selected air carriers on a worldwide basis to arrive at probable ground mishap averages.

F.R.L.

A73-24716 # Optimization of maintenance manuals to minimize error. E. L. Brown, A. A. Burrows, and W. L. Miles (Douglas Aircraft Co., Long Beach, Calif.). In: Human threats to air safety; Proceedings of the Twenty-fifth Annual International Air Safety Seminar, Washington, D.C., October 16-18, 1972.

Arlington, Va., Flight Safety Foundation, Inc., 1972, p. 180-190. 7 refs.

Fault isolation information for the DC-10 is contained in two manuals: (1) the fault isolation (FI) manual designed for in-flight use, and (2) the turn-around fault isolation (TAFI) manual designed for use by the mechanic during troubleshooting to identify the faulty line replaceable unit (LRU). All the information in these manuals is based on a very complete engineering analysis. The FI/TAFI information presentation philosophy and techniques are discussed, as well as FI/TAFI testing and operational experience. The advanced maintenance information (AMI) job package concept is described.

F.R.L.

A73-24767 Assessing the cost effectiveness of planned improvements. S. B. Poritzky (Air Transport Association of America, Washington, D.C.). *Journal of Air Traffic Control*, vol. 15, Mar.-Apr. 1973, p. 5-10.

The criteria for evaluating the cost-effectiveness of planned improvements in the aviation system are considered. The financial situation is discussed together with questions regarding ATC automation vs terminal aids, the noise problem, noise control by procedures, the replacement of ancient ground facilities, a higher capacity ATC

system, the automation base, terminal area ATC capacity improvements, and the enroute situation. Other subjects investigated include approaches for establishing cost-effectiveness and the cost-effectiveness of high-cost improvements. G.R.

A73-24768 Considerations for future approach operations. A. S. Crossfield (Eastern Air Lines, Inc., New York, N.Y.). *Journal of Air Traffic Control*, vol. 15, Mar.-Apr. 1973, p. 11-13.

A two-segment approach has been designed to reduce the approach noise impact upon colocated airport communities. A technique for reducing human errors in approach altitude interpretation and interpolation is reported. Category I, II, and III approaches are considered together with a number of new approach classes, aspects of cost and safety, a number of precision approaches, and some nonprecision approaches. G.R.

A73-24842 Hydrodynamic visualization of unsteady flows (Visualisation hydrodynamique d'écoulements instationnaires). H. Werlé (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). In: Recent research on unsteady boundary layers; Symposium, Quebec, Canada, May 24-28, 1971, Proceedings. Volume 2. Quebec, Presses de l'Université Laval, 1972, p. 1422-1443. 40 refs. In French.

Techniques for the study of flow patterns about models, based on flow visualization in water, are described, and the potentialities and limitations of these techniques are reviewed with respect to their application to unsteady flows. It is shown that, in spite of their imperfect similarity conditions due to low Reynolds numbers, these experimental techniques are at the origin of numerous results of considerable importance for pure and applied research reaching into several aerospace and industrial areas of interest. M.V.E.

A73-24875 Boeing sells a thousand 727s - and hopes to sell plenty more. J. P. Geddes. *Interavia*, vol. 28, Mar. 1973, p. 245-247.

The origins of the Boeing 727 design and the manufacturer's plans to follow up the 727 later in the decade through the 7X7 study program and cooperation with foreign companies are outlined. The ultimate 727 configuration with three engines in the rear was a compromise between a series of conflicting views in the airline industry. The most difficult development problems were surges in the inlet ducts, which caused engine failure, and structural and aerodynamic difficulties with the T-tail. Various modifications and improvements to the original 727 are discussed. Present plans on the proposed 7X7 are based on entering the intermediate market through joint ventures with Italy and Japan if there are firm airline commitments. F.R.L.

A73-24915 Symmetrical airfoils optimized for small flap deflection. F. X. Wortmann (Stuttgart, Universität, Stuttgart, West Germany). *Aero-Revue*, Mar. 1973, p. 147-150.

Wind-tunnel data obtained with aerodynamic control surfaces designed not as symmetrical but as cambered airfoils with a deflected flap are examined. Flap configurations providing optimum velocity distributions are discussed. V.P.

A73-24916 Electronic developments for high-performance glider flight. I (Elektronische Entwicklung für den Leistungsegelflug. I). I. Westerboer. (Organisation Scientifique et Technique Internationale du Vol à Voile, Congress, 13th, Vrsac, Yugoslavia, July 9-22, 1972.) *Aero-Revue*, Mar. 1973, p. 150, 151. In German.

Two electronic systems that will compensate the total energy of a rate-of-climb indicator are described. Some practical aspects of time-constant compensation and altitude (pressure decrease) error compensation are examined. V.P.

A73-24924 # Network planning and control of air transportation (Setevoe planirovanie i upravlenie na vozdušnom transporte). A. V. Miroshnikov, A. S. Kravets, and A. N. Khizhniak. Moscow, Izdatel'stvo Transport, 1971. 112 p. 12 refs. In Russian.

Discussion of the theory and implementation of civil aviation network planning and management procedures, covering their applications in aircraft maintenance, air traffic control, airport operations, labor and materials distribution, aircraft production, operations management, and cost analysis. Details are given on the application of network diagrams in a number of specific aircraft maintenance and servicing operations. Computer applications and the potential of the diagrammatic method as an instrument of optimization are also considered. V.Z.

A73-24925 # Gas turbine systems for engines with split exhaust gas discharge (Gazoturbinnye sistemy dvigatelei s razdelenym vypuskom gazov). M. G. Makhan'ko. Moscow, Izdatel'stvo Mashinostroenie, 1972. 120 p. 17 refs. In Russian.

Description of turbocharging systems for piston engines employing separate high- and low-pressure exhaust ports for each cylinder. The high-pressure exhaust ports are located in the cylinder wall and become uncovered by the piston at the end of its downward stroke, while the low-pressure ports are located in the head and act during the exhaust stroke. Systems are classified and analyzed on the basis of the manner in which the two exhaust ducts are applied to turbine stages driving the intake compressor. T.M.

A73-24949 Helo camera mount eases 80-million square mile job. V. O. McColley and W. W. Grass (U.S. Navy, Combat Camera Group, San Diego, Calif.). *Signal*, vol. 27, Apr. 1973, p. 20-23.

The advantages of the Nelson Tyler camera mount lie in the complete isolation of engine and airframe vibration from the camera. The delicate balance between camera and counter-balance enables the photographer to keep his picture horizon smooth and level despite any erratic changes in aircraft attitude. The operation of the mount is discussed and attention is given to questions of the mobility of the device. G.R.

A73-24965 Effectiveness of diffusion metallizing as a means of increasing the life of gas turbine blades. P. T. Kolomytsev, P. P. Lebedev, and L. A. Kostina (Voenno-Vozdushnaia Inzhenernaia Akademiia, Moscow, USSR). (*Zashchitnye Pokrytiia na Metallakh*, no. 4, 1971, p. 257-263.) *Protective Coatings on Metals*, vol. 4, 1972, p. 193-197. Translation.

Illustration of the use of diffusion metallization by chromium and aluminum to increase the longevity of parts made of heat-resistant materials at a comparatively low operating temperature (750 C). The efficiency of the turbine blades of the VK-1A engine is estimated from the results of full-scale tests of the endurance of uncoated and chromoaluminized blades after various times of operation on the engine. It is shown that in-vacuum chromoaluminizing significantly increases the operating life of these turbine blades, the endurance limit being increased from 650 to 1300 hr. A.B.K.

STAR ENTRIES

N73-18001*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

A METHOD FOR PREDICTING SHOCK SHAPES AND PRESSURE DISTRIBUTIONS ON TWO DIMENSIONAL AIRFOILS AT LARGE ANGLES OF ATTACK

George E. Kaattari Washington Mar. 1973 49 p refs (NASA-TN-D-7197; A-4564) Avail: NTIS HC \$3.00 CSCL 01A

A method is presented for determining shock envelopes and pressure distributions for two-dimensional airfoils at angles of attack sufficiently large to cause shock detachment and subsonic flow over the windward surface of the airfoil. Correlation functions obtained from exact solutions are used to relate the shock standoff distance at the stagnation and sonic points of the body through a suitable choice for the shock shape. The necessary correlation functions were obtained from perfect gas solutions but may be extended to any gas flow for which the normal shock-density ratio can be specified. Author

N73-18003*# Bell Aerospace Co., Buffalo, N.Y.

DEVELOPMENT AND APPLICATIONS OF SUPERSONIC UNSTEADY CONSISTENT AERODYNAMICS FOR INTERFERING PARALLEL WINGS

Kari Appa and G. C. C. Smith Washington. NASA Mar. 1973 57 p refs (Contract NAS1-10880)

(NASA-CR-2168) Avail: NTIS HC \$3.00 CSCL 01A

The analytical development of unsteady supersonic aerodynamic influence coefficients for isolated and nearly parallel interfering coplanar and noncoplanar wings is described. Numerical formulations based on triangular discretizations of wings and diaphragms are handled in a kinematically consistent manner. Examples of isolated wing cases are compared with respect to aerodynamic influence coefficients and flutter boundaries. Aerodynamic influence coefficients for interfering wings are compared where corresponding results are available. Author

N73-18004*# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Abteilung Aerodynamik.

INFLUENCE OF THE TRAILING EDGE SHAPE ON THE DRAG OF A RECTANGULAR WING IN THE MACH NUMBER RANGE FROM FREE STREAM MACH .5 TO 2.2

M. Tanner 1971 93 p refs In GERMAN; ENGLISH summary (DLR-FB-71-85) Avail: NTIS HC \$6.75; DFVLR Porz-Wahn: 28.80 DM

Drag and lift measurements were performed on two rectangular wings with an aspect ratio of 2 in the Mach number range from free stream Mach 0.5 to 2.2. The one wing had a sharp trailing edge and the other a blunt trailing edge. The shape of the blunt trailing edge and its thickness was varied. By using a broken trailing edge shape the drag of the wing with a blunt trailing edge was remarkably reduced. The total drag was split up in its components in order to show the magnitude of the various drag components. Author

N73-18005*# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Aerodynamik.

THEORETICAL PARAMETER STUDIES OF WING-FUSELAGE-COMBINATIONS

Horst Koerner 1972 40 p refs In GERMAN; ENGLISH summary (DLR-FB-72-63) Avail: NTIS HC \$4.00; DFVLR Porz: 11 DM

A parameter study is presented concerning the influence of the main geometry parameters on the aerodynamic characteristics of a wing-fuselage-combination in incompressible flow. For this study a prediction-method for wing-fuselage-combinations with cylindrical fuselages developed by H. Korner is used. The parameters investigated within this study are body-diameter, wing-position, sweep, planform-taper, and aspect ratio. Results are given for the lift slope and the aerodynamic centre of the total arrangement, in some cases also the local values along the span. Author

N73-18006*# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). (AVA)-Abteilung Aeroelastik.

CALCULATION OF THE UNSTEADY PRESSURE DISTRIBUTIONS ON HARMONICALLY OSCILLATING SLENDER CRUCIFORM WING AND CYLINDRICAL BODY COMBINATIONS

K. L. Chao 1971 96 p refs In GERMAN; ENGLISH summary (DLR-FB-71-87) Avail: NTIS HC \$7.00; DFVLR Porz-Wahn: 28.80 DM

Based upon the Slender-Body-Theory the theoretical relations for an analytical determination of the pressure distributions on harmonically oscillating slender cruciform wing and cylindrical body combinations in compressible flow are presented. For the analytical solution of the Laplace equation the method of conformal mapping has been applied, where the cross-section geometry is transformed into a straight line. The mutual interference effects of the cruciform wings and the influences of the fuselage body are investigated in detail for heaving, pitching and rolling oscillations. Author

N73-18007*# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Inst. fuer Aeroelastik.

UNSTEADY PRESSURE MEASUREMENTS ON A HARMONICALLY OSCILLATING WING MODEL IN THREE DIMENSIONAL COMPRESSIBLE FLOW

H. Triebstein 1972 135 p refs In GERMAN; ENGLISH summary (DLR-FB-72-55) Avail: NTIS HC \$8.75; DFVLR Porz-Wahn: 43.20 DM

Measurements of the unsteady pressure on a harmonically oscillating rectangular half wing model with control surface in three-dimensional compressible flow have been carried out at numerous parameter variations. For these measurements, which took place in the Transonic Wind Tunnel of DFVLR-AVA in Goettingen, a new test set-up has been developed. The model was performing pitching oscillations about the 1/4- and the half chord axis in the Mach regime $Ma = 0.5$ until 1.2; the Reynolds number regime was $Re = 1.3 \times 10^6$ to the 6th power until 4.8×10^6 to the 6th power. The investigations have been carried out with reduced frequencies $\omega^* = \omega b / V_\infty = 0.051$ up to 0.218. The experimental results are compared with corresponding theoretical results stemming from three-dimensional lifting surface theory and with relating experimental results from Nationaal Lucht- en Ruimtevaartlaboratorium, Amsterdam. In particular, the effects of the vibration amplitude, the angle of attack and the Reynolds number upon the unsteady pressure distributions were investigated in detail. Author

N73-18008*# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). (AVA)-Abteilung.

FORCE AND PRESSURE DISTRIBUTION MEASUREMENTS ON A WING-BODY COMBINATION WITH WING OF LOW ASPECT RATIO IN COMPRESSIBLE FLOW

W. Stahl, K. Hartmann, and W. Schneider 1972 39 p refs
In GERMAN; ENGLISH summary
(DLR-FB-72-08) Avail: NTIS HC \$4.00; DFVLR Porz-Wahn: 12, DM

In the transonic wind tunnel of the Aerodynamische Versuchsanstalt Goettingen experimental investigations were carried out on a wing-body combination with a delta wing of low aspect ratio ($\Lambda = 0.52$). The wing extended along most of the body, which was a circular cylinder with an ogival nose. Mach numbers ranged from $Ma = 0.5$ to 2.2 , covering the transonic regime. Normal forces and pitching moments were measured as well as spanwise pressure distributions in several sections on the pressure and suction sides. Oil-flow and smoke pictures gave some insight into the flow field. The Reynolds number, formed with $2/3$ of the length of the wing was held constant at $Re = 2,700,000$ for all Mach numbers. The influence of the Reynolds number was investigated at Mach numbers $Ma = 0.5, 1.0$ and 1.8 . Angles of incidence varied from alpha approximates 0 deg to alpha approximates 30 deg. For comparison purposes the results of the wing alone were available; they had been obtained at AVA in earlier investigations. Author

N73-18010*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

THEORETICAL AND EXPERIMENTAL INTERNAL FLOW CHARACTERISTICS OF A 13.97-CENTIMETER-DIAMETER INLET AT STOL TAKEOFF AND APPROACH CONDITIONS
James A. Albers Washington Mar. 1973 23 p refs.
(NASA-TN-D-7185; E-7237) Avail: NTIS HC \$3.00 CSCL 01A

The theoretical and experimental internal flow characteristics of a 13.97-cm-diam inlet with centerbody retracted and extended are presented at STOL takeoff and approach operating conditions. The theoretical results were obtained from incompressible potential flow corrected for compressibility and boundary layer. Comparisons between theoretical internal surface static-pressure distributions and experimental data are presented for free-stream velocities of $0, 24, 32$, and 45 m/sec for a range of inlet incidence angles from 0 to 50 deg. Surface static-pressure distributions are illustrated at circumferential locations of $0, 60, 120$, and 180 deg. Surface Mach number distributions from the stagnation point to the diffuser exit are presented along with turbulent boundary-layer shape factors. In general, good agreement was found between the theoretical and experimental surface static pressure distributions. Author

N73-18011*# Hamilton Standard, Windsor Locks, Conn.
ANALYTICAL PARAMETRIC INVESTIGATION OF LOW PRESSURE RATIO FAN NOISE
F. B. Metzger, D. B. Hanson, R. W. Menche, and G. B. Towle Washington NASA Mar. 1973 118 p refs
(Contract NAS1-10896)
(NASA-CR-2188; HSER-5990) Avail: NTIS HC \$3.00 CSCL 01B

The results of an analytical study are reported which shows the effect of various physical and operating parameters on noise produced by low pressure ratio propulsive fans operating at subsonic tip speeds. Acoustical duct lining effects are included in the study. The concepts used to develop the noise theory used in the study, as well as the correlation between the theory and model test results are also presented. It is shown that good correlation has been established between theory and experiment. Using the theory, it is shown that good aerodynamic design, maximum acceptable fan solidity, low tip speed operation and use of few blades and vanes leads to the lowest noise levels. Typical results of the study indicate that a fan operating at 1.2 fan pressure ratio and 700 ft/second tip speed with 12 blades and 7 vanes and including modest acoustic treatment on the duct wall would produce levels allowing a $100,000$ lb. STOL aircraft to meet a noise level objective of 95 Pndb at 500 ft at takeoff. Author

N73-18012*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECTS OF VANE-INDUCED ROTATION ON DIFFUSER

FLOW DISTORTION IN AN AXISYMMETRIC MIXED-COMPRESSION INLET

Edward T. Meleason Washington Feb. 1972 36 p refs
(NASA-TM-X-2752; E-7245) Avail: NTIS HC \$3.00 CSCL 20D

An investigation of vane-induced flow rotation to modify distorted steady-state total-pressure patterns in the subsonic diffuser of a supersonic mixed-compression inlet was conducted. Radial static-pressure gradients generated by the rotation were the mechanism used to modify the total-pressure distributions. Significant redistribution of circumferential distortion patterns into more compatible radial patterns was realized, but flow problems near the duct walls reduced the general effectiveness of the technique. Total-pressure losses associated with the swirl vanes were slight. Limited turbulence data indicated that vane installation resulted in reduced turbulence levels. Author

N73-18013*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.

MEASUREMENTS OF SURFACE-PRESSURE FLUCTUATIONS ON THE XB-70 AIRPLANE AT LOCAL MACH NUMBERS UP TO 2.45

Thomas L. Lewis, Jules B. Dods, Jr., and Richard D. Hanly Washington Mar. 1973 35 p refs
(NASA-TN-D-7226; H-714) Avail: NTIS HC \$3.00 CSCL 01C

Measurements of surface-pressure fluctuations were made at two locations on the XB-70 airplane for nine flight-test conditions encompassing a local Mach number range from 0.35 to 2.45 . These measurements are presented in the form of estimated power spectral densities, coherence functions, and narrow-band-convection velocities. The estimated power spectral densities compared favorably with wind-tunnel data obtained by other experimenters. The coherence function and convection velocity data supported conclusions by other experimenters that low-frequency surface-pressure fluctuations consist of small-scale turbulence components with low convection velocity. Author

N73-18016# East Anglia Univ., Norwich (England). School of Mathematics and Physics.

CALCULATION OF THE EFFECT OF BLOWING FROM THE LEADING EDGES OF A SLENDER DELTA WING

J. E. Barsby London Aeron. Res. Council. 1972 79 p refs
Supersedes RAE-TR-71077; ARC-33029 Sponsored by Min. of Defence
(ARC-R/M-3692; RAE-TR-71077; ARC-33029) Avail: NTIS HC \$6.00; HMSO £ 2.75; PHI \$10.80

The thin-jet model, applied to the study of the jet flap, is combined with the vortex-sheet model, applied to the study of leading-edge separation, to study the effect of blowing from the leading edges of a delta wing at incidence. A jet-vortex supporting a pressure difference related to the curvature of the streamlines in it, leaves the leading edge in a direction tangential to the wing plane and rolls up into a spiral above the wing. The inner part of the spiral is replaced by an asymptotic representation and the properties of this configuration are calculated by slender-body theory for the case of conical flow. The effect of the three basic parameters; the coefficient of blowing momentum, the initial angle between the jet streamlines and the leading edge, and the ratio of the angle of incidence to the apex angle of the wing, are covered in the calculations. Blowing is shown to increase the lift on the wing and to increase the circulation about the vortex, while displacing it upwards and outboard. Comparisons with experimental results are encouraging. Author (ESRO)

N73-18018# Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.

THE MEASUREMENT AND ANALYSIS OF THE PROFILE DRAG OF A WING WITH A SLOTTED FLAP

I. R. M. Moir, D. N. Foster, and D. R. Holt (Hawker Siddeley Aviation, Brough, Engl.) London Aeron. Res. Council 1972 37 p refs
Supersedes RAE-TR-71158; ARC-33663
(ARC-CP-1233; RAE-TR-71158; ARC-33663) Avail: NTIS HC \$4.00; HMSO 60 p; PHI \$2.65

Measurements of lift, drag, and pitching moments were made on a wing section for a range of flap deflections under conditions which were as close as possible to two-dimensional flow. The corrected data are presented together with the results of a semi-empirical analysis of sectional profile drag. It is shown that a consistent analysis can be made of the results over a range of flap angles and incidence, limited by a requirement for acceptable wing and flap boundary layer conditions, precluding significant flow separations. Under these conditions it appears that such an approach could serve as a general basis for correlating and interpreting experimental data on high-lift mechanical flap arrangements. Author (ESRO)

N73-18019*# Youngstown State Univ., Ohio. William Rayen School of Engineering.
A SOLID STATE CONVERTER FOR MEASUREMENT OF AIRCRAFT NOISE AND SONIC BOOM Final Report, 1 Sep. 1971 - 31 Aug. 1972
 Allan J. Zuckerwar 30 Nov. 1972 61 p refs
 (Grant NGR-36-028-004)
 (NASA-CR-112260) Avail: NTIS HC \$5.25 CSCL 20A

The problems inherent in present systems of instrumentation for measuring aircraft noise and sonic boom include limited frequency response, expensive connecting cables, sensitivity to cable length and type, high sensitivity to environmental conditions, and additional limitations of individual system components. Furthermore, differing requirements have resulted in the use of two different systems for aircraft noise and sonic boom measurements respectively. To alleviate these difficulties a unified system of instrumentation suitable for both types of measurements was developed. The system features a new solid state converter connected to a zero drive amplifier. The system was found insensitive to cable length and type up to at least 1000 ft and requires no impedance matching networks. The converter itself has flat frequency response from dc to 28 kHz (-3 db), dynamic range of 72 db, and noise floor of 50 db in the band 22.4 Hz to 22.4 kHz. Author

N73-18020*# California Inst. of Tech., Pasadena.
EXPERIMENTAL STUDY OF FLOW ABOUT A STALLED TWO-DIMENSIONAL AIRFOIL Semiannual Status Report, Jun. - Dec. 1972
 D. Coles, A. Wadcock, and B. Cantwell Jan. 1973 25 p
 (Grant NGL-05-002-229)
 (NASA-CR-130919; SASR-2; SASR-3) Avail: NTIS HC \$3.25 CSCL 01C

Wind tunnel tests to determine the flow characteristics of a stalled wing are described. The advantages of the plane wing over the ring wing for wind tunnel investigations are presented. The general flow pattern for stalled ring airfoils is developed. Photographs of the test equipment and installation are provided. Author

N73-18021*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
INITIAL FLIGHT AND SIMULATOR EVALUATION OF A HEAD UP DISPLAY FOR STANDARD AND NOISE ABATEMENT VISUAL APPROACHES
 Kent Bourquin, Everett Palmer, George Cooper, and Ronald Gerdes Feb. 1973 39 p refs
 (NASA-TM-X-62187) Avail: NTIS HC \$4.00 CSCL 01B

A preliminary assessment was made of the adequacy of a simple head up display (HUD) for providing vertical guidance for flying noise abatement and standard visual approaches in a jet transport. The HUD featured gyro-stabilized approach angle scales which display the angle of declination to any point on the ground and a horizontal flight path bar which aids the pilot in his control of the aircraft flight path angle. Thirty-three standard and noise abatement approaches were flown in a Boeing 747 aircraft equipped with a head up display. The HUD was also simulated in a research simulator. The simulator was used to familiarize the pilots with the display and to determine the most suitable way to use the HUD for making high capture noise abatement approaches. Preliminary flight and simulator data are presented and problem areas that require further investigation are identified. Author

N73-18022*# Boeing Co., Seattle, Wash.
FLIGHT TEST MEASUREMENTS AND ANALYSIS OF SONIC BOOM PHENOMENA NEAR THE SHOCK WAVE EXTREMITY
 George T. Haglund and Edward J. Kane Washington NASA Feb. 1973 178 p refs
 (Contract NAS1-10992)
 (NASA-CR-2167; D6-40758) Avail: NTIS HC \$3.00 CSCL 20A

The sonic boom flight test program conducted at Jackass Flats, Nevada, during the summer and fall of 1970 consisted of 121 sonic-boom-generating flights over the 1500 ft instrumented BREN tower. This test program was designed to provide information on several aspects of sonic boom, including caustics produced by longitudinal accelerations, caustics produced by steady flight near the threshold Mach number, sonic boom characteristics near lateral cutoff, and the vertical extent of shock waves attached to near-sonic airplanes. The measured test data, except for the near-sonic flight data, were analyzed in detail to determine sonic boom characteristics for these flight conditions and to determine the accuracy and the range of validity of linear sonic boom theory. The caustic phenomena observed during the threshold Mach number flights and during the transonic acceleration flights are documented and analyzed in detail. The theory of geometric acoustics is shown to be capable of predicting shock wave - ground intersections, and current methods for calculating sonic boom pressure signature away from caustics are shown to be reasonably accurate. Author

N73-18023# Advisory Group for Aerospace Research and Development, Paris (France).
TECHNICAL EVALUATION REPORT ON FLUID DYNAMICS PANEL SPECIALISTS MEETING ON FLUID DYNAMICS OF AIRCRAFT STALLING
 R. C. Pankhurst (Royal Aircraft Estab., Teddington, UK) Nov. 1972 11 p refs Conf. held at Lisbon, 26-28 Apr. 1972
 (AGARD-AR-49) Avail: NTIS HC \$3.00

An evaluation of the fluid dynamics of aircraft stalling is presented. The aerodynamic characteristics of the aircraft stall at both low and high speeds are discussed. Particular reference is made to the design and operation of combat and transport aircraft, including buffet penetration and post-stall behavior. Major subject areas concern flight experience, flight testing, wind tunnel measurements, and theoretical prediction methods. The effects of three dimensional flow, the influence of sweep back, and the design and performance of light lift devices are analyzed. Author

N73-18024*# United Aircraft Corp., Stratford, Conn. Sikorsky Aircraft Div.
ACTIVE TRANSMISSION ISOLATION/ROTOR LOADS MEASUREMENT SYSTEM Final Report
 Irwin J. Kenigsberg and John J. DeFelice 1 Mar. 1973 139 p refs Sponsored in part by Army Air Mobility Res. and Devel. Lab.
 (Contract NAS1-11549)
 (NASA-CR-112245; SER-50821) Avail: NTIS HC \$9.00 CSCL 01B

Modifications were incorporated into a helicopter active transmission isolation system to provide the capability of utilizing the system as a rotor force measuring device. These included: (1) isolator redesign to improve operation and minimize friction, (2) installation of pressure transducers in each isolator, and (3) load cells in series with each torque restraint link. Full scale vibration tests performed during this study on a CH-53A helicopter airframe verified that these modifications do not degrade the systems wide band isolation characteristics. Bench tests performed on each isolator unit indicated that steady and transient loads can be measured to within 1 percent of applied load. Individual isolator vibratory load measurement accuracy was determined to be 4 percent. Load measurement accuracy was found to be independent of variations in all basic isolator operating characteristics. Full scale system load calibration tests on the CH-53A airframe established the feasibility of simultaneously providing wide band vibration isolation and accurate measurement of rotor loads. Principal rotor loads (lift, propulsive force, and torque) were measured to within 2 percent of applied load. Author

N73-18025

**N73-18025*# North Carolina State Univ., Raleigh.
AN ANALYTICAL STUDY OF THE RESPONSE OF A
CONSTANT-ATTITUDE AIRCRAFT TO ATMOSPHERIC
TURBULENCE**

Frederick O. Smetana and Ronald K. Carden Washington NASA
Mar. 1973 51 p refs
(Contract NAS1-9603)
(NASA-CR-2204) Avail: NTIS HC \$3.00 CSCL 01B

A light airplane equipped with an automatic control system which drives large wing flaps and the stabilator so as to produce a constant pitch attitude in all flight modes was analyzed for its response to a specific gust. The aircraft was also equipped with a bank-angle steering, zero sideslip automatic control system which was studied for its effectiveness in suppressing a specific lateral gust. The gusts were assumed to be comprised of 200 lateral and 400 vertical sinusoids. Each was used to excite the controlled aircraft, and the time response to the sum of all sinusoids was plotted. The assumption was that the gust may be treated as stationary in space but variable in time rather than the reverse. Results indicate that such a control system can suppress vertical gusts up to the limit of control authority. Either the lateral accelerations or the yawing velocity response to lateral gusts can be suppressed with this system but not both simultaneously. Author

**N73-18026# Deutsche Forschungs- und Versuchsanstalt fuer
Luft- und Raumfahrt, Stuttgart (West Germany). Inst. fuer
Drehfluegelflugzeuge.**

**CALCULATION OF THE FLAPWISE BENDING, EDGEWISE
BENDING AND TORSIONAL VIBRATIONS OF ROTOR
BLADES WITH COUPLED NATURAL MODES AND FRE-
QUENCIES**

Hans Oette 1971 82 p refs In GERMAN; ENGLISH summary
(DLR-FB-71-108) Avail: NTIS HC \$6.25; DFVLR Porz:
18.50 DM

The natural mode method is expanded from one to two degrees of freedom for three coupled degrees of flapwise bending, edgewise bending and torsion. For the coupled natural modes known, the orthogonal relations are arranged and the differential equations for the generalized degrees of freedom are derived. The theory is still extended by adding the moment of inertia due to the extension of the blade across to its axis and applying a flapping coordinate system. For the numerical examples the following items are taken into account: The forward flight data of the S-61 helicopter, coupled natural modes computed by the multihinge articulated blade method, and schematized nonstationary aerodynamic coefficient curves. Author

**N73-18027# Deutsche Forschungs- und Versuchsanstalt fuer
Luft- und Raumfahrt, Goettingen (West Germany). Inst. fuer
Aeroelastik.**

**DYNAMIC AND AEROELASTIC PROBLEMS OF STOP-
ROTORS AND THEIR ANALYTICAL TREATMENT. PART
1: ANALYTICAL DETERMINATION OF THE NATURAL
VIBRATIONS OF ROTOR BLADES AND THE STEADY AND
UNSTEADY AIRLOADS ON THE BLADE DURING STOPPING
AND RETRACTING**

H. Foersching and G. Kotowski 1972 133 p refs In GERMAN;
ENGLISH summary
(DLR-FB-72-65-Pt-1) Avail: NTIS HC \$8.75; DFVLR Porz-Wahn:
42 DM

Some dynamic and aeroelastic problems of stop-rotors of V/STOL-aircraft, occurring during retracting and stowing the blades, are treated in detail. In the first part of the investigations presented in this report first the physical background of rotor dynamic phenomena is discussed by means of some typical experimental results. Then, for an analytical treatment of these problems, the basic elastomechanical and aerodynamic relations are elaborated, in particular, methods for calculating the characteristic vibration behavior of rotor blades with initial twist, the generalized dynamic equations, and the aerodynamic loads on the blade during stopping and retracting. As a typical example the calculation of the natural vibrations of a rotor blade is presented in an appendix. Author

**N73-18028# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
A DETERMINISTIC MODEL OF SONIC BOOM PROPAGA-**

TION THROUGH A TURBULENT ATMOSPHERE

B. H. K. Lee and H. S. Ribner Ottawa Natl. Res. Council of
Can. Nov. 1972 24 p refs Sponsored by Natl. Res. Council
of Can.

(NRC-12981; LR-566) Avail: NTIS HC \$3.25

The propagation of a weak normal shock wave through a turbulent atmosphere is studied in terms of an idealized model. The turbulent field is assumed to be weak and represented by the superposition of two inclined shear waves of opposite inclination to the mean flow. The resulting flow is of a cellular nature. The cells are rectangular in shape and the sense of rotation of the flow alternates from cell to cell. If the angles made by the normal of the incident shear waves with the direction of the mean flow are greater than some critical value, an exponentially decaying pressure wave is generated behind the shock. Spiked or rounded waveforms are obtained by adding or subtracting this pressure wave from the steady state pressure field. An illustrative example for a mean flow Mach number of 1.0005 is considered. This gives a steady state overpressure of 2.45 pounds per square foot across the shock which is typical of the overpressure in a sonic boom. Author

**N73-18029# Cranfield Inst. of Technology (England). Coll. of
Aeronautics.**

**A COMPARATIVE ASSESSMENT OF THREE METHODS OF
MEASUREMENT OF PRESSURE ERROR CORRECTIONS**

M. E. Eshelby Jun. 1972 25 p refs
(CRANFIELD-AERO-11) Avail: NTIS HC \$3.25

Three methods of evaluating the pressure error of an aircraft pitot-static system are presented. The relative merits of each method are compared. In particular the determination of static pressure error by a trailing cone is considered as a method suitable for use on light aircraft and comparison is made between the pressure error measured by the cone and the other methods. Author

**N73-18030# Advisory Group for Aerospace Research and
Development, Paris (France).**

**RECENT DEVELOPMENTS IN FLIGHT FLUTTER TESTING
IN THE UNITED STATES. SUPPLEMENT TO THE MANUAL
ON AEROELASTICITY, VOLUME 4, CHAPTER 10**

E. F. Baird (Grumman Aerospace Corp.) and W. B. Clark (Grumman
Aerospace Corp.) Dec. 1972 27 p refs Presented at 34th
AGARD Struct. and Mater. Panel Meeting, Lyngby, Denmark,
11 Apr. 1972

(AGARD-R-596) Avail: NTIS HC \$3.50

Advances in the rapid and accurate determination of flutter characteristics through the use of high speed computers are discussed. Comments are presented on some flight flutter testing procedures in use and under development. A model matching technique is described. This technique reduces data analysis time and is compatible with relatively fast data acquisition. Results of model matching when applied to theoretical response data are presented and compared with actual flight flutter testing. Author

**N73-18031*# National Aeronautics and Space Administration.
Ames Research Center, Moffett Field, Calif.**

**TAKEOFF CERTIFICATION CONSIDERATIONS FOR LARGE
SUBSONIC AND SUPERSONIC TRANSPORT AIRPLANES
USING THE AMES FLIGHT SIMULATOR FOR ADVANCED
AIRCRAFT**

C. Thomas Snyder, Fred J. Drinkwater, III, Emmett B. Fry, and
Raymond D. Forrest (FAA, Washington, D. C.) Washington Mar.
1973 76 p refs Prepared in cooperation with FAA, Washington,
D. C.
(NASA-TN-D-7106; A-3778) Avail: NTIS HC \$3.00 CSCL
01B

Data for use in development of takeoff airworthiness standards for new aircraft designs such as the supersonic transport (SST) and the large wide-body subsonic jet transport are provided. An advanced motion simulator was used to compare the performance and handling characteristics of three representative large jet transports during specific flight certification tasks. Existing regulatory constraints and methods for determining rotation speed were reviewed, and the effects on takeoff performance of variations

in rotation speed, pitch attitude, and pitch attitude rate during the rotation maneuver were analyzed. A limited quantity of refused takeoff information was obtained. The aerodynamics, wing loading, and thrust-to-weight ratio of the subject SST resulted in takeoff speeds limited by climb (rather than lift-off) considerations. Take-off speeds based on U.S. subsonic transport requirements were found unacceptable because of the criticality of rotation-abuse effects on one-engine-inoperative climb performance. Adequate safety margin was provided by takeoff speeds based on proposed Anglo-French supersonic transport (TSS) criteria, with the limiting criterion being that takeoff safety speed be at least 1.15 times the one-engine-inoperative zero-rate-of-climb speed. Various observations related to SST certification are presented. Author

N73-18032# Aeronautical Center, Oklahoma City, Okla. Flight Standards Technical Div.

A SUMMARY OF CRASHWORTHINESS INFORMATION FOR SMALL AIRPLANES

Feb. 1973 125 p refs

(FAA-TR-FS-70-592-120A) Avail: NTIS HC \$8.25

An analysis of parameters affecting the safety of occupants of light aircraft in the event of a crash is presented. The data involves: (1) airframe design, (2) interior components, (3) restraint systems, (4) protective padding, and (5) types of hazards encountered. The test facilities and research programs for simulating aircraft accidents to determine extent of aircraft damage and nature of the forces developed are described. Human tolerance to impact deceleration forces and the extremity strike envelope for the human body under various types of restraint are analyzed. P.N.F.

N73-18033# Cranfield Inst. of Technology (England). **AEROPLANE DESIGN STUDY STOL AIRLINER (A71). PART 2: DETAIL DESIGN FEATURES**

D. Howe Jul. 1972 33 p refs

(AERO-13-Pt-2) Avail: NTIS HC \$3.75

Detail design features of a short takeoff and landing commercial aircraft are presented. The design of the structures and systems is conventional in most respects. The need to provide a long stroke undercarriage for STOL operations incurred a large weight penalty. The design has demonstrated an inability to cope with engine failure and gusting cross wind conditions. The effect of the STOL requirement on the overall airframe construction is analyzed. Author

N73-18034*# Lockheed-California Co., Van Nuys. Rotary Wing Div.

VIBRATION AND LOADS IN HINGELESS ROTORS. VOLUME 1: THEORETICAL ANALYSES

G. A. Watts and R. J. London Sep. 1972 278 p refs Sponsored in part by Army Air Mobility Res. and Develop. Lab. 2 Vol. (Contract NAS2-5168)

(NASA-CR-114562) Avail: NTIS HC \$16.00 CSCL 01C

Analytic methods are developed for calculating blade loads and shaft-transmitted vibratory forces in stiff bladed hingeless rotors operating at advance ratios from $\mu = .3$ to $\mu = 2.0$. Calculated shaft harmonic moments compared well with experimental values when the blade first flap frequency was in the region of two-per-revolution harmonic excitation. Calculated blade bending moment azimuthal distributions due to changes in cyclic pitch agreed well with experiment at radial stations near the blade root at values of the ratio of first flap frequency to rotor rotation rate from 1.5 to 5.0. At stations near the blade tip good agreement was only obtained at the higher values of frequency ratio. Author

N73-18035*# Lockheed-California Co., Van Nuys. Rotary Wing Div.

VIBRATION AND LOADS IN HINGELESS ROTORS. VOLUME 2: EXPERIMENTAL DATA

G. A. Watts and R. J. London Sep. 1972 272 p refs Sponsored in part by Army Air Mobility Res. and Develop. Lab. 2 Vol. (Contract NAS2-5168)

(NASA-CR-114568) Avail: NTIS HC \$15.75 CSCL 01C

Descriptions, geometry, and technical data covering three

rotor systems are presented. Tables of experimental data gathered during wind tunnel testing of two of the systems are included. Both analyzed experimental data, ready for comparison with theory, and the basic reduced data from which they were obtained are reported. Author

N73-18036*# LTV Aerospace Corp., Hampton, Va.

A STUDY OF THE EFFECTS OF AEROELASTIC DIVERGENCE ON THE WING STRUCTURE OF AN OBLIQUE-WING SUPERSONIC TRANSPORT CONFIGURATION

Jan. 1973 17 p refs

(Contract NAS1-10900)

(NASA-CR-112262) Avail: NTIS HC \$3.00 CSCL 01B

The aerodynamic characteristics of transport aircraft with oblique wing flying at supersonic speeds are discussed. Aeroelastic divergence of the forward swept portion of the wing is analyzed. The effect of aspect ratio as a method for avoiding aeroelastic divergence is examined. A relatively low aspect ratio appears necessary for an oblique wing when constructed of conventional aluminum alloy materials. The aspect ratio may be increased by increasing the wing thickness ratio and by utilizing materials with higher moduli of elasticity and rigidity. Author

N73-18037*# North Carolina State Univ., Raleigh.

A DESIGN STUDY FOR A SIMPLE-TO-FLY, CONSTANT ATTITUDE LIGHT AIRCRAFT

Frederick O. Smetana, Douglas E. Humphreys, Rafael J. Montoya, William W. Rickard, and Ivan E. Wilkinson Washington NASA Mar. 1973 322 p refs

(Grant NGR-34-002-086)

(NASA-CR-2208) Avail: NTIS HC \$6.00 CSCL 01B

The activities during a four-year study by doctoral students to evolve in detail a design for a simple-to-fly, constant attitude light airplane are described. The study indicated that such aircraft could materially reduce the hazards to light airplane occupants which arise from the high pilot work load and poor visibility that occur during landing. Preliminary cost studies indicate that in volume production this system would increase the cost of the aircraft in roughly the same fashion that automatic transmission, power steering, power brakes, and cruise control increase the cost of a compact car. Author

N73-18038*# Boeing Co., Seattle, Wash.

CONCEPTUAL DESIGN STUDIES OF CANDIDATE V/STOL LIFT FAN COMMERCIAL SHORT HAUL TRANSPORT FOR 1980 - 1986 V/STOL LIFT FAN STUDY

W. M. Eldridge, J. A. Ferrell, J. W. McKee, J. E. Wayne, Jr., and J. M. Zabinsky Washington NASA Feb. 1973 100 p refs

(Contract NAS2-6563)

(NASA-CR-2183) Avail: NTIS HC \$3.00 CSCL 01C

Conceptual designs of V/STOL lift fan commercial short haul transport aircraft for the 1980-85 time period were studied to determine their technical and economic feasibility. The engine concepts included both integral and remote fans. The scope of the study included definition of the hover control concept for each propulsion system, aircraft design, aircraft mass properties, cruise performance, noise and ride qualities evaluation. Economic evaluating was also studied on a basis of direct operating costs and route structure. Author

N73-18039*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

PRELIMINARY STUDY OF SUPERSONIC TRANSPORT CONFIGURATIONS WITH LOW VALUES OF SONIC BOOM

James F. Dugan, Jr. Washington Mar. 1973 36 p refs

(NASA-TM-X-2746; E-6770) Avail: NTIS HC \$3.00 CSCL 01C

A parametric study of low-boom supersonic transport airplanes with conventional configurations was made to identify the features of specific configurations that promise relatively low sonic boom overpressures (less than 47.9 N/sq m). The range of values considered was gross weight from 28,300 to 170,000 kg; cruise Mach numbers of 2 to 3.2; and wing loadings of 1436, 2870, and 4309 N/sq m. Fuselage length was varied from 49.1 to

N73-18040

102.4 m and fuselage diameter from 2.75 to 3.98 m. A nominal Mach 2 configuration weighing 56,700 kg and having a wing loading of 2870 N/sq m was selected; and its gross geometric, aerodynamic, and structural features were estimated. At a cruise altitude of 18,300 m, lift-drag ratio was estimated to be 7.35, while sonic boom overpressure was 41.7 N/sq m. Takeoff thrust loading using four afterburning turbojet engines at maximum dry thrust was 0.32. Payload for a 4440-km range was 16.7 percent of gross weight, giving a direct operating cost of 0.82 cents per seat/statute mile. Author

N73-18040* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

ALUMINUM RUNWAY SURFACE AS POSSIBLE AID TO AIRCRAFT BRAKING

C. David Miller and I. Irving Pinkel Washington Mar. 1973 33 p refs

(NASA-TN-D-7186; E-7046) Avail: NTIS HC \$3.00 CSCL 01E

Several concepts are described for use singly or in combination to improve aircraft braking. All involve a thin layer of aluminum covering all or part of the runway. Advantage would derive from faster heat conduction from the tire-runway interface. Heating of tread surface with consequent softening and loss of friction coefficient should be reduced. Equations are developed indicating that at least 99 percent of friction heat should flow into the aluminum. Preliminary test results indicate a coefficient of sliding friction of 1.4, with predictably slight heating of tread. Elimination of conventional brakes is at least a remote possibility. Author

N73-18041* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

ACOUSTIC CHARACTERISTICS OF A SEMISPAN WING EQUIPPED WITH AN EXTERNALLY BLOWN JET FLAP INCLUDING RESULTS AT FORWARD SPEED

Michael D. Falarski Washington Mar. 1973 84 p refs Prepared in cooperation with Army Air Mobility R and D Lab., Moffett Field, Calif.

(NASA-TM-X-2749; A-4469) Avail: NTIS HC \$3.00 CSCL 01B

A wind-tunnel investigation was made of the noise characteristics of a 14.5-ft semispan, externally blown jet flap model. The model was equipped with a single 30-in. diameter, ducted fan with a 1.03 pressure ratio. The effects of flap size, fan vertical location, and forward speed on the noise characteristics were studied. With the ducted fan mounted 0.79 or 1.24 diameters below the wing and a flap chord greater than 50 percent, the peak perceived noise level increased 2 to 3 Pndb when the flap was deflected to 90 deg. The jet scrubbing noise increased 3 to 4 db when the flap was deflected 90 deg. Installation of the fan on the wing was responsible for 1 to 2 db of this change. Forward speed did not have a significant effect on the perceived noise level, although it did cause a reduction in the sound pressure levels of the first and second fan harmonics. Author

N73-18042* Michigan Univ., Ann Arbor.

A STUDY OF THE DYNAMIC TIRE PROPERTIES OVER A RANGE OF TIRE CONSTRUCTIONS

G. H. Nybakken, R. N. Dodge, and S. K. Clark Washington NASA Mar. 1973 35 p refs Revised (Grant NGL-23-005-010)

(NASA-CR-2219; Rept-056080-19-T-Rev) Avail: NTIS HC \$3.00 CSCL 01C

The dynamic properties of four model aircraft tires of various construction were evaluated experimentally and compared with available theory. The experimental investigation consisted of measuring the cornering force and the self-aligning torque developed by the tires undergoing sinusoidal steering inputs while operating on a small scale, road-wheel tire testing apparatus. The force and moment data from the different tires are compared with both finite- and point-contact patch string theory predictions. In general, agreement between finite contact patch theory and experimental observation is good. A modified string theory is also presented in which coefficients for cornering force and self-aligning torque are determined separately. This theory

improves the correspondence between the experimental and analytical data, particularly on tires with relatively high self-aligning torques. Author

N73-18044* Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).

RESULTS AND KNOWLEDGE GAINED IN AERODYNAMIC JET INTERFERENCE FROM THE VSTOL JET TRANSPORT AIRCRAFT DO 31 AND THEIR APPLICATION TO FUTURE VSTOL DEVELOPMENTS [ERGEBNISSE UND ERFAHRUNGEN ZUR AERODYNAMISCHEN STRAHINTERFERENZ BEIM VSTOL-STRAHLTRANSPORTFLUGZEUG DO 31 UND IHRE ANWENDUNG AUF ZUKUNFTIGE VSTOL-ENTWICKLUNGEN]

Dieter Welte Bonn Bundeswehramt 1972 183 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Verteidigung (BMVg-FBWT-72-22) Avail: NTIS HC \$11.25; Bundeswehramt 25 DM

The most important results concerning jet interference effects for the Do-31 aircraft, resulting from wind tunnel model measurements and flight tests, are presented, and an estimation is given of jet interference effects for future VSTOL project studies. Calculations are based on a single semi-empirical method for determination of jet-induced lift-loss in hovering for simple configurations such as the Do-31, and it is possible to calculate the lift-loss to within 1 percent accuracy. The investigation of the jet-induced flow field around the Do-31 during hovering with ground effect and in the transition flight regime yielded a rough estimation of the jet interference effects for future VSTOL studies. ESRO

N73-18045* Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).

SOUND RADIATION IN THE SHORT AND LONG RANGE OF THE VSTOL JET TRANSPORT AIRCRAFT DO 31 AND NOISE REDUCTION POSSIBILITIES FOR FUTURE V/STOL DEVELOPMENTS [SCHALLABSTRAHLUNG IM NAH- UND FERNFELD DES VSTOL-STRAHLTRANSPORTERS DO 31 UND LAERMINDERUNGSMOEGlichkeiten BEI ZUKUNFTIGEN VSTOL-ENTWICKLUNGEN]

Peter Bartels Bonn Bundeswehramt 1972 167 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. der Verteidigung (BMVg-FBWT-72-23) Avail: NTIS HC \$10.50; Bundeswehramt 25 DM

Results of theoretical and experimental investigations of noise in the near and far field of the VSTOL jet transport aircraft Do 31 are presented in condensed form. Particular attention was given to the problem of aircraft noise reduction in the vicinity of existing airports, which is already possible with the Do 31, and to the noise and noise reduction of existing and future VSTOL concepts. The high flexibility in the selection of flight procedures makes the VSTOL aircraft the only vehicle adaptable to local circumstances. This is important not only from a military point of view, but more generally for optimal economy and noise reduction. Author (ESRO)

N73-18046* Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).

THE DO 31 LANDING LOADS DURING VERTICAL LANDING AND THEIR CONSEQUENCES FOR FUTURE VSTOL DEVELOPMENTS [DIE LANDELASTEN DER DO 31 BEI VERTIKALLANDUNGEN UND FOLGERUNGEN FUER ZUKUNFTIGE VSTOL-ENTWICKLUNGEN]

Wolfgang Schoernack Bonn Bundeswehramt 1972 72 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. der Verteidigung (BMVg-FBWT-72-24) Avail: NTIS HC \$5.75; Bundeswehramt 25 DM

The results of 83 vertical landings carried out during the Do 31 VSTOL Experimental Program are reported. During 23 landings, undercarriage reactions, as well as sinking speeds were measured; of the remaining 60 landings only sinking speeds could be evaluated. Undercarriage reaction factors and sinking

speeds are plotted as frequency distributions and discussed. The result of the evaluation of the landing experiments can be summarized as follows: VTOL airplanes of a conception similar to the Do 31 and using manual control during the end of descent would experience considerably higher sinking speeds than conventional aircraft. Furthermore, a typical jumping of the airplane after touchdown and a following second impact prove unfavorable, this second impact resulting in higher undercarriage reactions than the first one. The horizontal loads occurring with vertical landings are smaller than expected. Author (ESRO)

N73-18047# Honeywell, Inc., Minneapolis, Minn. Systems and Research Div.

AN INVESTIGATION OF AIRBORNE DISPLAYS AND CONTROLS FOR SEARCH AND RESCUE (SAR). VOLUME 6: AVIONICS REQUIREMENTS FOR THE HH-53C HELICOPTER Final Report, Sep. 1971 - Jan. 1972

O. Herbert Lindquist, B. A. Olson, A. Jones, and James W. Wingert May 1972 103 p refs
(Contract N00014-69-C-0406; NR Proj. 213-072)
(AD-752625; HONEYWELL-12609-FR1-Vol-6;
JANAIR-720902-Vol-6) Avail: NTIS CSCL 06/7

An analytical study was conducted to define the avionics system and the display and controls concept required for the HH-53C helicopter so that it could accomplish the USAF's all-weather SAR mission. The study tasks included development of an avionics concept based on a representative mission scenario, avionics and sensor package selection, a man/machine function allocation and crew workload analysis. A recommended avionics configuration was defined. The HH-53C can be upgraded by an avionics configuration, within the cost constraints, to perform the all-weather SAR mission. This upgraded HH-53C can be operated by the crew within their workload limitations.

Author (GRA)

N73-18048# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DETERMINATION OF THE OPTIMUM REVERSING COEFFICIENT OF THRUST REVERSALS FOR THE ENGINES OF PASSENGER AIRCRAFT

A. G. Gilson 7 Nov. 1972 11 p refs Transl. into ENGLISH from Tr. Aviats. Inst. (Kazan), no. 127, 1970 p 28-34
(AD-752814; FTD-MT-24-1482-72) Avail: NTIS CSCL 01/2

A simple empirical method is proposed for determining the overall required negative thrust and the required coefficient of reversal based on average statistical data on the magnitude of the reversible thrust capacity (ratio of the overall thrust of the reverser to the weight of the aircraft) of modern passenger airplanes with thrust reverser. This ratio for various types of aircraft ranges from 0.24 to 0.30 (the larger figures apply to number of engines with thrust reverser as a function of the coefficient of reversal).

Author (GRA)

N73-18049# Naval Aerospace Medical Research Lab., Pensacola, Fla.

MAJOR ORIENTATION-ERROR ACCIDENTS IN REGULAR ARMY UH-1 AIRCRAFT DURING FISCAL YEAR 1969: ACCIDENT FACTORS

W. Carroll Hixson, Jorma I. Niven, and Emil Spezia Oct. 1972 39 p refs Prepared in cooperation with Army Aeromed. Res. Lab., Fort Rucker, Ala.
(MF51524005)

(AD-753208; NAMRL-1169; USAARL-73-2) Avail: NTIS CSCL 01/2

The report is the third dealing with pilot disorientation/vertigo problem in Regular Army UH-1 helicopter operations. Individual case history data extracted from the USABAAR master aircraft accident files are presented on 44 major orientation-error accidents that occurred in UH-1 aircraft during fiscal year 1969. Summary data listings involving a variety of operational and pilot-related accident factors are presented for each of the cases.

Author (GRA)

N73-18050# Naval Air Development Center, Warminster, Pa. Air Vehicle Technology Dept.
PRELIMINARY DESIGN AND COST STUDY OF RECIRCULA-

TING CHROMATE RINSE SYSTEM FOR AIRCRAFT CORROSION CONTROL

K. G. Clark and W. C. Hallow 2 Nov. 1972 20 p refs
(AD-753214; NADC-72183-VT) Avail: NTIS CSCL 01/3

Aircraft rinse facilities are presently employed to remove corrosive salt deposits from aircraft operating in salt laden environments. While water rinsing has been effective in reducing corrosion, the rate of attack can be further reduced by introducing a small amount of corrosion inhibitor, such as potassium dichromate, into the rinse water. The report presents a preliminary design and cost study for such a recirculating chromate rinse system.

GRA

N73-18051# Pennsylvania State Univ., University Park. Dept. of Aerospace Engineering.

A NUMERICAL SOLUTION FOR AN UNSTEADY TWO-DIMENSIONAL JET-FLAPPED WING

Glen E. Potter Nov. 1972 81 p refs
(Grant DA-ARO(D)-31-124-G13)

(AD-752928; AROD-9334-1-E) Avail: NTIS CSCL 01/3

A numerical solution of the two-dimensional jet-flapped airfoil utilizing discrete vortices to represent airfoil and jet vortex distributions is presented for two time-dependent cases. The first concerns an instantaneous deflection of the jet exit angle and the second case involves continuous oscillation of the jet angle.

Author (GRA)

N73-18052# Naval Air Development Center, Warminster, Pa. Systems Analysis and Engineering Dept.

OPTIMAL CONTROL OF THE F-8C IN A FULLY AUTOMATIC CARRIER APPROACH Final Report

Roger J. Bannett 7 Nov. 1972 142 p refs
(AD-753010; NADC-SD-7153) Avail: NTIS CSCL 01/2

The report presents a detailed exposition of the problems associated with landing high performance jet fighter aircraft on board a moving aircraft carrier along with a new procedure for designing a fully automatic flight control system tailored to the aircraft carrier approach. Included in the development is a brief description of the present SPN-42 ACLS (Aircraft Carrier Landing System) and the probable reason for its very limited success. Possible alternatives to the SPN-42 system have suggested a more sophisticated ACLS configuration, in particular, the AMOAC (Automatic Multiloop Optimal Approach Controller) developed herein. The use of an AMOAC system in actual carrier approaches should yield a substantial improvement to present automatic carrier landing capability.

Author (GRA)

N73-18053# United Aircraft Corp., East Hartford, Conn. Research Labs.

INVESTIGATION OF AIRFOIL DYNAMIC STALL AND ITS INFLUENCE ON HELICOPTER CONTROL LOADS Final Report

Franklin O. Carta, Gerald L. Commerford, Raymond G. Carlson, and Robert H. Blackwell Sep. 1972 209 p refs
(Contract DAAJ02-71-C-0003; DA Proj. 1F1-62204-A-139)
(AD-752917; USAAMRDL-TR-72-51) Avail: NTIS CSCL 01/3

Measurements were made of the unsteady normal force and pitching moment on an NACA 0012 airfoil model oscillated both sinusoidally and nonsinusoidally over a range of incidence angles, including a substantial penetration into stall. The sinusoidal normal force and pitching moment data were reduced and tabulated as functions of the angle of attack, the angular velocity parameter, and the angular acceleration parameter. This generalized form of the data was used to reconstruct the measured sinusoidal aerodynamic response of the model airfoil with excellent results. Additional correlations were made using nonsinusoidal pitch schedules which included periodic ramp changes in angle of attack and a flexured angular blade response to a one-per-rev sinusoidal incidence angle change typical of that for a helicopter blade. The agreement between predicted and measured normal force and moment loops was very good for the ramp motion.

Author (GRA)

N73-18054# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FLOW AROUND WING PROFILE WITH THE PRESENCE ON THE SURFACE OF A SYSTEM OF SOURCES AND SINKS
 B. S. Baev and V. N. Zhuravlev 20 Oct. 1972 12 p refs
 Transl. into ENGLISH of Teplo- i Massopereenos (USSR), no. 12, 1969 p 383-386
 (FTD Proj. T70-01-12)
 (AD-752686; FTD-HT-23-834-72) Avail: NTIS CSCL 01/3

The article examines the determination of aerodynamic characteristics during flow around a profile by a plane-parallel flow of an incompressible, ideal fluid for the following arrangements: a sink and source in a single plane; a sink and source in different planes; a sink on the upper surface. The solution is carried out by applying the theory of the function of a complex variable and by the method of the conformal transformation of a unit circle onto the profile. Author (GRA)

N73-18055# Schjeldahl (G. T.) Co., Northfield, Minn. Advanced Programs Div.
DESIGN AND MANUFACTURE OF A 670,000 CUBIC FOOT NATURAL SHAPE BALLOON FOR PROJECT POBAL Final Report, Oct. 1971 - Aug. 1972
 James B. Munson 15 Sep. 1972 62 p refs
 (Contract F19628-72-C-0108)
 (AD-753086; SER-0159; AFCRL-72-0614) Avail: NTIS CSCL 01/3

The configuration and manufacture of a 670,000 cubic foot, natural shape, zero pressure, free flight balloon is described. Requirements, design calculations, documentation, fabrication, testing and inspection are discussed. Author (GRA)

N73-18056# Environmental Health Lab., Kelly AFB, Tex.
NOISE SURVEY, F-105 OVERFLIGHTS, WICHITA MOUNTAINS WILDLIFE REFUGE AND VICINITY, FORT SILL, OKLAHOMA
 Alvin R. Frazier Sep. 1972 70 p refs
 (AD-753113; EHL(K)-72-21) Avail: NTIS CSCL 06/6

A noise survey quantitated the environmental noise levels which would be produced by F-105 aircraft flights over the Quanah Weapons Range located on Fort Sill. Data were obtained at a nearby Job Corp Center, Camp Boulder located on the adjoining Wichita Mountains Wildlife Refuge and the cities of Cache and Indianola. Adverse effects on the environment are predicted to be minimal and serious interference with present or future land uses is not expected. After serious consideration of many factors, the benefits to be gained through the proposed joint use of this existing artillery range outweigh the minimal adverse effects that would develop because of the flyby noise. Author (GRA)

N73-18057# Logistics Management Inst., Washington, D.C.
OPTIMUM SERVICE LIFE DETERMINATION TECHNIQUE
 Nov. 1972 70 p refs
 (Contract SD-271; SD Proj. 271-168)
 (AD-752747; LMI-72-12) Avail: NTIS CSCL 01/3

The report describes efforts by LMI to determine feasible methods of attaining the following dual interrelated objectives: to improved long-range predictions of the safe remaining structural life of groups of Naval aircraft (e.g., all Navy F-4Bs) to be used statistically to facilitate and support decisions regarding major structural modification programs, programmed aircraft model service life and service life extensions, and planning of the future military role to be filled by given aircraft models, and to improved short-range predictions of the structural condition of individual Naval aircraft, which can be used to develop a maintenance strategy (e.g., inspection intervals) which would increase the probability of aircraft meeting operational commitments without major structural problems. Author (GRA)

N73-18058# Northrop Corp., Palos Verdes Peninsula, Calif. Electronics Div.
UH-1 TEST BED PROGRAM, VOLUME 1 Final Report
 Robert R. Butcher, Russell Kirby, Jr., John Nakakihara, and T. C. Watkins Jun. 1972 418 p refs
 (Contract DAAJ01-70-C-0828; DA Proj. 1F1-64204-DC-32)

(AD-752890; NORT-71-293A-Vol-1;
 USAAVSCOM-TR-72-19-Vol-1) Avail: NTIS CSCL 01/3

The UH-1H helicopter test bed program was accomplished at the U.S. Army Aeronautical Depot Maintenance Center (ARADMAC), Corpus Christi, Texas, during the period 4 October 1970 through 17 December 1971. The program objective was to determine the capability of state-of-the-art hardware to automatically accomplish inspection, diagnostic and prognostic maintenance functions on selected subsystems of the UH-1H helicopter. Northrop's hardware for the program is identified as a Maintenance Reporting System (MRS). Helicopter components, both serviceable and degraded, were run and monitored for malfunction discrimination by the MRS in ARADMAC test cells and in two UH-1H aircraft. Trending for prognosis was attempted while accumulating flight time on two additional UH-1H aircraft utilizing serviceable components. The test results demonstrated the objectives of the test bed program. Author (GRA)

N73-18059# Northrop Corp., Palos Verdes Peninsula, Calif. Electronics Div.
UH-1 TEST BED PROGRAM, VOLUME 2 Final Report
 Robert R. Butcher, Russell Kirby, Jr., John Nakakihara, and T. C. Watkins Jun. 1972 111 p
 (Contract DAAJ01-70-C-0828)
 (AD-752891; NORT-72-220A-Vol-2;
 USAAVSCOM-TR-72-19-Vol-2) Avail: NTIS CSCL 01/3

The document presents accomplishments during Phase E of the UH-1H Helicopter Test Bed Program for an Automatic Inspection, Diagnostic and Prognostic System conducted at the U.S. Army Aeronautical Depot Maintenance Center (ARADMAC), Corpus Christi, Texas, from 1 October 1971 through 17 December 1971. Author (GRA)

N73-18060# Hamilton Standard, Windsor Locks, Conn.
UH-1H AIDAPS TEST BED PROGRAM, VOLUME 1 Final Report, 4 Oct. 1970 - 17 Dec. 1971
 James Provenzano, John Games, Al Wyrostek, Art Ostheimer, and Jack Young 31 Aug. 1972 347 p
 (Contract DAAJ01-70-C-0827; DA Proj. 1F1-64204-DC-32)
 (AD-752893; HSER-6080-Vol-1;
 USAAVSCOM-TR-72-18-Vol-1) Avail: NTIS CSCL 01/3

The UH-1H helicopter Test Bed Program was accomplished at the U.S. Army Aeronautical Depot Maintenance Center, Corpus Christi, Texas, during the period 4 October 1970 through 17 December 1971. The program objective was to determine the feasibility of state-of-the-art hardware to automatically accomplish inspection, diagnostic and prognostic maintenance functions on selected subsystems of the UH-1H helicopter. The Hamilton Standard hardware for the program is identified as Airborne Integrated Diagnostic System (AIDS). Helicopter components, both serviceable and degraded, were run and monitored for malfunction discrimination by the AIDS in ARADMAC test cells and in two UH-1H aircraft. Trending for prognosis was attempted while accumulating flight time on two additional UH-1H aircraft utilizing serviceable components. Author (GRA)

N73-18061# Hamilton Standard, Windsor Locks, Conn.
UH-1H AIDAPS TEST BED PROGRAM, VOLUME 2 Final Technical Report
 James Provenzano, John Games, Al Wyrostek, Art Ostheimer, and Jack Young Aug. 1972 345 p
 (Contract DAAJ01-70-C-0827; DA Proj. 1F1-64204-DC-32)
 (AD-752894; HSER-6080-Vol-2;
 USAAVSCOM-TR-72-18-Vol-2) Avail: NTIS CSCL 01/3

The report contains a description of airborne checkout sensors, their installation points, and their checkout parameters. Included is a computer aided analysis of the checkout procedures and results obtained. GRA

N73-18062# Northrop Corp., Palos Verdes Peninsula, Calif. Electronics Div.
CONCEPT FORMULATION STUDY FOR AUTOMATIC INSPECTION, DIAGNOSTIC AND PROGNOSTIC SYSTEMS (AIDAPS). VOLUME 1: SUMMARY Final Report
 Sep. 1972 72 p refs

(Contract DAAJ01-71-C-0503)

(AD-752882; NORT-71-292A-Vol-1;

USAAVSCOM-TR-72-20-Vol-1) Avail: NTIS CSCL 01/3

The report presents the results of a concept formulation study for an Automatic Inspection, Diagnostic and Prognostic System (AIDAPS) for Army aircraft. The purpose of the study was to satisfy the prerequisites of contract definition as defined in the life cycle management model for Army systems. The study results conclusively demonstrate that these prerequisites were satisfied. Author (GRA)

N73-18063# Northrop Corp., Palos Verdes Peninsula, Calif. Electronics Div.

CONCEPT FORMULATION STUDY FOR AUTOMATIC INSPECTION, DIAGNOSTIC AND PROGNOSTIC SYSTEMS (AIDAPS). VOLUME 2: AIDAPS DESIGN AND TRADE STUDIES Final Report

Sep. 1972 623 p

(Contract DAAJ01-71-C-0503)

(AD-752883; NORT-71-292A-Vol-2;

USAAVSCOM-TR-72-20-Vol-2) Avail: NTIS CSCL 01/3

The objective of this study is to determine the most cost effective approach to the Army requirement for an Automatic Inspection Diagnostic and Prognostic System (AIDAPS). The system must automatically diagnose mechanical malfunctions, warn of impending mechanical failures, and eliminate unnecessary inspections or part removals. It must also permit the change of aircraft components on an on-condition basis instead of a time change basis. The ultimate goals of the program are to reduce aircraft life cycle ownership costs, increase aircraft availability and improve aircraft safety. Author (GRA)

N73-18064# Northrop Corp., Palos Verdes Peninsula, Calif. Electronics Div.

CONCEPT FORMULATION STUDY FOR AUTOMATIC INSPECTION, DIAGNOSTIC AND PROGNOSTIC SYSTEMS (AIDAPS). VOLUME 3: TECHNICAL PROPOSAL RECOMMENDED DEVELOPMENT PLAN Final Report

Sep. 1972 128 p

(Contract DAAJ01-71-C-0503)

(AD-752884; NORT-71-292A-Vol-3;

USAAVSCOM-TR-72-20-Vol-3) Avail: NTIS CSCL 01/3

The report presents a proposed plan for the development and deployment of the Universal Modular AIDAPS prepared in accordance with the Army Data Item, DI-S-1803. The end items of the systems are defined; work breakdowns, milestone schedules and PERT networks are given for the development efforts. Schedules and PERT networks for the adaptation, data collection, operational testing and deployment for all the aircraft types which are included are suggested; an AIDAPS maintenance plan and a product assurance plan are submitted; development costs and costs for ten years beyond project go-ahead are tabulated; an Integrated Logistics Support plan is suggested; development documentation requirements and schedules for submittal are established; and the anticipated duties, tasks and capabilities of AIDAPS-related Army personnel are discussed. Author (GRA)

N73-18065# Northrop Corp., Palos Verdes Peninsula, Calif. Electronics Div.

CONCEPT FORMULATION STUDY FOR AUTOMATIC INSPECTION, DIAGNOSTIC AND PROGNOSTIC SYSTEMS (AIDAPS). VOLUME 4: AIDAPS GENERAL SPECIFICATION Final Report

Sep. 1972 29 p

(Contract DAAJ01-71-C-0503)

(AD-752885; NORT-71-292A-Vol-4;

USAAVSCOM-TR-72-20-Vol-4) Avail: NTIS CSCL 01/3

The specification establishes the technical and mission requirements for the Automatic Inspection, Diagnostic and Prognostic System (AIDAPS) as an entity, allocates requirements to functional areas, and defines the interfaces between or among the functional areas. This specification is based on parameters developed during the concept formulation phase and shall be used to establish the general nature of the AIDAPS to be further defined during the development phase. Author (GRA)

N73-18066# Northrop Corp., Palos Verdes Peninsula, Calif. Electronics Div.

CONCEPT FORMULATION STUDY FOR AUTOMATIC INSPECTION, DIAGNOSTIC AND PROGNOSTIC SYSTEMS (AIDAPS). APPENDIX C: AIDAPS COMPUTER MODELS Final Report

Sep. 1972 157 p

(Contract DAAJ01-71-C-0503)

(AD-752886; NORT-71-292-App-C;

USAAVSCOM-TR-72-20-App-C) Avail: NTIS CSCL 01/3

The appendix presents the computer models developed to perform the AIDAPS Concept Formulation Study Program. The three models used are the AIDAPS Procurement Cost Model, AIDAPS/Aircraft Maintenance Analysis Model, and the AIDAP System Cost Benefit Model. The AIDAPS Procurement Cost Model is utilized to compute the cost factors used to calculate the cost of implementing AIDAPS into the Army system which includes all substantial initial investment and ownership costs. The AIDAPS/Aircraft Maintenance Analysis Model is used to calculate the effectiveness achieved by AIDAPS application. The AIDAP System Cost Benefit Model computes AIDAPS life cycle costs, cost savings, and benefits derived from using AIDAPS, and develops the net savings and benefits. Author (GRA)

N73-18067# Northrop Corp., Palos Verdes Peninsula, Calif. Electronics Div.

CONCEPT FORMULATION STUDY FOR AUTOMATIC INSPECTION, DIAGNOSTIC AND PROGNOSTIC SYSTEMS (AIDAPS). APPENDIX D: COMPUTER OUTPUT DATA Final Report

Sep. 1972 381 p

(Contract DAAJ01-71-C-0503)

(AD-752887; NORT-71-292-App-D;

USAAVSCOM-TR-72-20-App-D) Avail: NTIS CSCL 01/3

The computer runs used in the AIDAPS tradeoffs are included in this appendix. These runs were programmed according to the model discussed in Appendix C, AIDAPS/Aircraft Computer Models. Section 1 contains computer printouts for the Unique AIDAPS configurations for each of the aircraft. Section 2 contains the computer runs for the Group and Universal AIDAP systems. An explanation of the information contained in each of the four distinctive printouts is presented here. A sample of each of the four printouts, numbered in accordance with the following discussion, is included. Author (GRA)

N73-18068# Northrop Corp., Palos Verdes Peninsula, Calif. Electronics Div.

CONCEPT FORMULATION STUDY FOR AUTOMATIC INSPECTION, DIAGNOSTIC AND PROGNOSTIC SYSTEMS (AIDAPS). APPENDIX E: UH-1 MAINTENANCE DATA TABULATIONS Final Report

Sep. 1972 727 p

(Contract DAAJ01-71-C-0503)

(AD-752888; NORT-71-292-App-E;

USAAVSCOM-TR-72-20-App-E) Avail: NTIS CSCL 01/3

Computer tabulations reflecting the maintenance history as reported under The Army Maintenance Management System (TAMMS), formerly (TAERS), for the aircraft being considered are presented in this report. These tabulations provide the reported maintenance requirements at Organizational, Direct Support (DS), General Support (GS) and Depot levels of maintenance. Author (GRA)

N73-18069# Northrop Corp., Palos Verdes Peninsula, Calif. Electronics Div.

CONCEPT FORMULATION STUDY FOR AUTOMATIC INSPECTION, DIAGNOSTIC AND PROGNOSTIC SYSTEMS (AIDAPS). APPENDIX F: AIDAPS PARAMETER LISTS Final Report

Sep. 1972 66 p

(Contract DAAJ01-71-C-0503)

(AD-752889; NORT-71-292-App-F;

USAAVSCOM-TR-72-20-App-F) Avail: NTIS CSCL 01/3

A Concept Formulation Study to determine the impact of AIDAPS on the maintenance of selected Army aircraft has been performed. The Study was conducted in three phases. In Phase

A the feasibility of the AIDAPS concept was confirmed; in Phase B practical AIDAP Systems were identified and cost effectiveness mathematical models were formulated; and in Phase C the models were operated and using Army maintenance and cost data, the optimum AIDAPS configurations and the potential life-cycle cost savings as a result of the application of AIDAPS were determined. The Study showed that the combat effectiveness of Army aircraft can be increased through the application of Modular Universal AIDAPS and that its use will be overwhelmingly life-cycle cost effective for the AH-1, UH-1, OV-1, CH-47 and CH-54 type aircraft. Combat effectiveness will be increased for the U-21, OH-6 and OH-58 type aircraft but AIDAPS will not provide sufficient return on investment to be considered cost effective. Author (GRA)

N73-18070# Boeing Co., Philadelphia, Pa. Vertol Div.
AN INVESTIGATION OF NOISE GENERATION ON A HOVERING ROTOR. PART 2 Final Report, 1 Feb. 1971 - 31 Jul. 1972

H. Sternfeld, C. Bobo, D. Carmichael, T. Fukushima, and R. Spencer
Nov. 1972 107 p refs
(Contract DAHC04-69-C-0087)
(AD-753397; D210-10550-1-Pt-2; AROD-8704-3-E-Pt-2) Avail: NTIS CSCL 20/1

The study is a natural extension of the program to investigate noise generation on a hovering rotor reported in a previous investigation. That program acquired data on a large (60 ft.) diameter rotor operating on a whirl tower, and evaluated that data in the light of established analytical procedures. The work described in this report compares available data in order to investigate the effects of variations in rotor design. This data which was available from other test programs included variations in number of blades of similar airfoil, airfoil, and platform. Also included is an evaluation of model testing by comparison of the results of the full size helicopter rotor with a one-eleventh scale model. Author (GRA)

N73-18071# Army Aviation Systems Test Activity, Edwards, AFB, Calif.

FLIGHT EVALUATION ELLIOTT LOW-AIRSPPEED SYSTEM Final Report, 21 Jun. - 15 Nov. 1971

Albert L. Winn and James S. Kishi Sep. 1972 39 p refs
(AD-753343; USAASTA-71-30; FR-1) Avail: NTIS CSCL 01/4

Airspeed calibration tests were conducted on an experimental model of the Elliott low-airspeed system to determine its suitability for use as a helicopter airspeed instrument. The airspeed system was mounted in various locations on the UH-1C helicopter. Emphasis was placed on the low-speed flight regimes where the sensor operated in rotor downwash. The evaluation required 13.7 productive test flight hours. The system provides reliable, accurate airspeed data from hover to 120 knots in the direction for which the sensor is mounted, and results indicate an omnidirectional system is feasible. The system is simple, is highly reliable, should be relatively inexpensive in production quantities, and has high potential for development into a standard aircraft instrument. Author (GRA)

N73-18072# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
STUDY OF IMPULSIVE SOUND GENERATED BY ROTOR TIPS ACCELERATING NEAR THE SONIC SPEED Final Report, 25 Jun. 1969 - 24 Jun. 1971

Richard H. Lyon 1 Nov. 1972 23 p Revised
(AD-752301; AROD-8705-2-E) Avail: NTIS CSCL 20/1

The principal results obtained are summarized as follows: Compressibility effects at the rotor tip during high speed forward flight are an important noise source. An acoustical model appears to give reasonable predictions of observed sound levels and directionality. Thickness radiation generally dominates lift radiation. By modifying the tip planform, section, and chord, sound level reductions can be achieved of the order of 10 db or more. The thickness distributions as derived appear sufficiently smooth so that they should be aerodynamically well behaved. Author (GRA)

N73-18073# Massachusetts Inst. of Tech., Cambridge. Flight Transportation Lab.

A SYSTEMS STUDY OF NOISE REQUIREMENTS AND EXPERIMENTAL INVESTIGATION OF NOISE SOURCES FOR V/STOL AIRCRAFT Final Report, 24 Jun. 1969 - 23 Jun. 1972

Robert W. Simpson Sep. 1972 13 p refs
(Contract DAHC04-69-C-0086)
(AD-752447; AROD-8713-3-E) Avail: NTIS CSCL 01/3

The report presents a summary of the problems studied and the results and conclusions reached in an investigation of the effect of noise problems and constraints on V/STOL aircraft design and operation, with the emphasis on helicopters. Author (GRA)

N73-18074# Naval Postgraduate School, Monterey, Calif.
EXPLORATORY STUDY OF THE TURNING CHARACTERISTICS OF A COANDA-OPERATED JET FLAP M.S. Thesis

James Houston Blakeney Sep. 1972 76 p refs
(AD-753618) Avail: NTIS CSCL 01/3

An exploratory investigation of the jet deflection characteristics of a jet-flapped airfoil with Coanda deflection surfaces was performed. Velocity distribution and flow angle measurements were made with the jetflap in static operation. Flow visualization tests were used to determine the turning characteristics in incompressible flow. Author (GRA)

N73-18075# Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
COLLECTION AND ANALYSIS OF SINK SPEED DATA AS PART OF THE X-22A FLIGHT RESEARCH PROGRAM Final Report

John L. Beilman 15 Nov. 1972 38 p
(Contract N00019-71-C-0044)
(AD-753852; CAL-TB-3011-F-1) Avail: NTIS CSCL 01/3

Very little experimental data exists on the landing impact loads encountered during landings of V/STOL airplanes. Development of criteria for predicting these loads has been initiated with the collection of data on the X-22A flight research program. Special instrumentation has been installed in the X-22A to measure sink rate data during landing approaches. The instrumentation was calibrated before and during the flight tests. Data was obtained for 31 landings, and statistical analyses were performed. Because of the small number of landings involved in this program, a firm statistical data base cannot be obtained, but certain trends are apparent. Histograms of the pertinent parameters are presented to show these trends, and tables of data obtained for each flight are included. Author (GRA)

N73-18076# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

INVESTIGATION OF STABILITY AND CONTROL CHARACTERISTICS OF AC130 LINEAR MODELS M.S. Thesis

Robert G. Lorenz Mar. 1972 92 p refs
(AD-753388; GAM/AE/72-5) Avail: NTIS CSCL 01/4

Mathematical models of the AC130A and AC130E aircraft are proposed. The models are developed from linearized equations and are referred to trim conditions of level turning flight. The proposed AC130E model is compared to an existing model to ascertain whether any significant differences exist between the two. A qualitative comparison is conducted by investigating each model's response to control deflections. The proposed AC130A model is used to predict general trends and probable values for stability derivatives and selected mode parameters over an extensive flight envelope. Author (GRA)

N73-18077# Hughes Tool Co., Culver City, Calif. Aircraft Div.
OH-6A PHASE 2 QUIET HELICOPTER PROGRAM Final Report, Apr. 1970 - Apr. 1971

William H. Barlow, William C. McCluskey, and Harold W. Ferris Sep. 1972 69 p refs
(Contract DAAJ02-69-C-0078; ARPA Order 1321)
(AD-753646; HTC-AD-71-102; USAAMRDL-TR-72-29) Avail: NTIS CSCL 01/3

The report presents the results of the Phase 2 Quiet Helicopter Program. A Hughes OH-6A Light Observation Helicopter was extensively modified to obtain a maximum of quieting. The

purpose was to apply the latest known sound-suppression techniques available to industry to an actual helicopter and then to measure the results. An acoustic goal was set which required a balanced treatment of each noise-producing source throughout the full frequency range. Noise reductions ranged from 14 to 20 db depending on the flight conditions. The report describes the detailed configuration changes, the test and development programs, and the final sound level measurements compared to the standard OH-6A. Author (GRA)

N73-18081# Advisory Group for Aerospace Research and Development, Paris (France).

TECHNICAL EVALUATION REPORT ON 39TH PROPULSION AND ENERGETICS PANEL MEETING ON ENERGETICS FOR AIRCRAFT AUXILIARY POWER SYSTEMS

R. H. Johnson (AFAPL), C. E. Oberly (AFAPL), and R. E. Quigley, Jr. (AFAPL) : Nov. 1972 11 p refs Conf. held at Colorado Springs, 12-15 Jun. 1972

(AGARD-AR-50) Avail: NTIS HC \$3.00

An evaluation of a conference to discuss current and future developments in aircraft electrical and auxiliary power systems is presented. Superconductivity phenomena as related to power generation are emphasized. The anticipated requirements imposed on weight, volume, and performance of auxiliary power systems which must operate in a high temperature environment are analyzed. Author

N73-18082# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

EXPERIMENTAL TEST RESULTS OF A GENERALIZED PARAMETER FUEL CONTROL

Peter G. Batterton and Harold Gold Washington Mar. 1973 29 p refs

(NASA-TN-D-7198; E-7254) Avail: NTIS HC \$3.00 CSCL 21D

Considerable interest has been generated recently in low cost jet propulsion systems. One of the more complicated components of jet engines is the fuel control. Results of an effort to develop a simpler hydromechanical fuel control are presented. This prototype fuel control was installed on a J85-GE-13 jet engine. Results show that the fuel control provided satisfactory engine performance at sea level static conditions over its normal nonafterburning operating range, including startup. Results of both bench and engine tests are presented; the difficulties encountered are described. Author

N73-18168# National Academy of Sciences-National Research Council, Washington, D.C.

PROCEEDINGS OF A SYMPOSIUM ON AN APPRAISAL OF HALOGENATED FIRE EXTINGUISHING AGENTS

1972 350 p refs Conf. held at Washington, D.C., 11-12 Apr. 1972

(AD-753218) Avail: NTIS CSCL 13/12

The report presents the papers given at the symposium and consists essentially of two groups: Toxicology and Performance. The topics covered include: Principles and procedures for toxicologic and physiologic evaluation of the Safety of Materials; Use of human volunteers; Inhalation injuries in fires; Toxicology of pyrolysis products of halogenated agents; Toxicology of Halon 1211; Halon 1301; Cardiovascular and nervous system effects of Bromotrifluoromethane; Use of Halon 1301 in surface and deep-seated fires, aircraft cabin, and cargo fires, gasoline fires, shipboard fires, submarine fires, and explosions and propellant fires; and the Use of Halon 1211 in hand extinguishers and fixed systems. GRA

N73-18173# Lincoln Lab., Mass. Inst. of Tech., Lexington.

A MAXIMUM-LIKELIHOOD MULTIPLE-HYPOTHESIS TESTING ALGORITHM, WITH AN APPLICATION TO MONOPULSE DATA

E. J. Kelly Feb. 1973 27 p refs

(Contracts DOT-FA72WAI-261; F19628-73-C-0002; FAA Proj. 034-241-012)

(TN-1973-7) Avail: NTIS HC \$3.50

A simple algorithm for multiple-hypothesis testing, based on

a generalization of likelihood ratio testing between pairs of hypotheses, is developed and applied to a specific problem. The problem arises in connection with an amplitude comparison monopulse system in an Air Traffic Control application. In particular, it is desired to measure target azimuth in a beacon system in the presence of interference and multipath. The multiple hypotheses relate to the presence or absence of a desired signal, with or without either of two kinds of interfering signal. The analysis leads to a new technique of data editing, or processing, to detect the presence of interference. Author

N73-18176# Lincoln Lab., Mass. Inst. of Tech., Lexington.

ATC SURVEILLANCE/COMMUNICATION ANALYSIS AND PLANNING Quarterly Technical Summary, 1 Sep. - 30 Nov., 1972

1 Dec. 1972 48 p refs

(Contracts DOT-FA72WAI-242; F19628-70-C-0230)

(FAA-RD-72-136) Avail: NTIS HC \$4.50

Analysis and planning activities reported include: (1) analyses of S/C requirements, near miss/collision data, desirable weather data processing and display systems, recorded data from an operational ATCRBS/ARTS-3 site; (2) a quasi-step-scan radar technique potentially capable of improving the clutter rejection performance of existing ATC radars; and (3) the status of a test program to obtain and analyze data on the effects of cyclically switching between transponder antennas. Author

N73-18179# Lockheed Missiles and Space Co., Palo Alto, Calif.

INDEPENDENT RADAR SYSTEMS, CHAPTER 6

D. S. Kontorov and Iu. S. Golubov-Novozhilov [1972] 15 p refs Transl. into ENGLISH from the book "Vvedenie v Radiolokatsionnuu Sistemotekhniku" Sovetskoe Radio, Moscow, 1971 p 167-184

Avail: NTIS HC \$3.00; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The design and construction of independent radar systems to determine target motion and nonkinematic parameters are discussed. The system is comprised of a peripheral information source, a central information processor, and a communication subsystem, together with a correlation matrix to measure target parameter error. It is concluded that independent systems using circular scan radars are apparently the most feasible, and the most practical application is found in air traffic control systems. J.M.M.

N73-18223# Martin Marietta Corp., Denver, Colo.

STUDY OF FEASIBILITY OF SOLID-STATE ELECTRIC SWITCH GEAR FOR AIRCRAFT AND SPACECRAFT Final Report

E. Buchanan and D. Waddington Mar. 1973 154 p refs

(Contract NAS3-15824)

(NASA-CR-121140; MCR-72-327) Avail: NTIS HC \$9.75 CSCL 09A

The design of a solid-state circuit breaker that can be interconnected to a second breaker to form a transfer switch is presented. The breaker operates on a nominal 270-V dc circuit and controls power to loads of up to 15 A. Automatic overload trip is provided as a function of excess energy measured through the breaker and/or excess current through the breaker. After an overload trip, up to nine preprogrammable attempts to reclose may be tried with programmable delays between each attempt. The breaker or switch is remotely controllable. Test data on performance in the laboratory over temperatures from -45 to 100 C are provided. The feasibility of solid-state switch gear has been established. Author

N73-18246# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany). Inst. fuer Angewandte Gasdynamik.

TEMPERATURE MEASUREMENTS IN WIND TUNNELS

J. Baete 1972 59 p refs In GERMAN; ENGLISH summary (DLR-Mitt-72-27) Avail: NTIS HC \$5.00; DFVLR PORZ: 17.30 DM

A survey is given on methods used for the measurement of temperature in wind tunnels of the DFVLR Institute for Applied Gas Dynamics by means of electric contact thermometers. It is

followed by indications on possible measuring errors and by an estimation of the accuracy. References of special methods on thermometry are mentioned on reports with a detailed description of these problems. Author

N73-18247# National Research Council of Canada, Ottawa (Ontario). Div. of Mechanical Engineering.
SNOW ACCUMULATIONS ON AIR CUSHION VEHICLE TRACK SECTIONS

T. R. Ringer and R. D. Price Oct. 1972 47 p refs
(NRC-12939; DME-MD-52) Avail: NTIS HC \$4.50

Snow accumulations have been observed on a number of different shaped beams that may be employed for guided air cushion train tracks. At low wind velocities the snowfall accumulation was similar on all horizontal surfaces; however at high wind velocities the beams with a plane upper horizontal surface accumulated much lower quantities of snow. The vertical member of the inverted Tee track acts as a 100% density snow fence for snowfall with a crosswind. Author

N73-18248# Weapons Research Establishment, Salisbury (Australia).

THE DATA ACQUISITION SYSTEM FOR THE WRE S-1 WIND TUNNEL

R. E. Kane Oct. 1972 41 p refs
(WRE-TN-784(WR/D)) Avail: NTIS HC \$4.25

The first phase became operational in May 1972 when the system was connected to the S-1 tunnel, a continuous flow subsonic/supersonic tunnel operating in the Mach number range 0.3 to 1.0 and 1.4 to 2.8. The system, based on a PDP15/20 computer, acquires analog and digital data from the tunnel and records them on compatible magnetic tape. It can be used for on-line or off-line reduction and manipulation of the data and for display of raw or processed data. The computer is also used for setting and controlling the attitude of a model and for accurately positioning a probe in the flow field. An outline of the system design, expected performance and interfacing design is given. Author

N73-18250# Advisory Group for Aerospace Research and Development, Paris (France).

AERODYNAMIC TEST SIMULATION: LESSONS FROM THE PAST AND FUTURE PROSPECTS

Julius Lukasiewicz, ed. (Carleton Univ.) Dec. 1972 89 p refs
Presented at AIAA 10th Aerospace Sci. Meeting Panel Discussion, San Diego, Calif., 19 Jan. 1972
(AGARD-R-603) Avail: NTIS HC \$6.50

Developments in aerodynamic test facilities used by government, university, and industry are discussed. The following topics are reported: (1) assessment of past experience, (2) present status and future prospects of aerodynamic and air breathing propulsion testing in all speed regimes, (3) ground test and flight comparisons, (4) free flight test techniques, and (5) the development of aerodynamic testing. A review of the major West European wind tunnels and a discussion of aerodynamic test facilities in the United States are included in two appendices. Author

N73-18256# Little (Arthur D.), Inc., Cambridge, Mass.
EVALUATION OF AUXILIARY AGENTS AND SYSTEMS FOR AIRCRAFT GROUND FIRE SUPPRESSION, PHASE 1 Final Report, 29 Nov. 1971 - 13 Mar. 1972

S. Atallah, Ashok S. Kalelkar, and John Hagopian Wright-Patterson AFB, Ohio ASD Aug. 1972 90 p refs
(Contract F33657-72-C-0422)
(AD-753069; ADL-74159; ASD-TR-72-75) Avail: NTIS CSCL 13/12

The program was conducted with the ultimate objective of reducing the number and types of auxiliary extinguishing agents and systems used for aircraft ground fire suppression at military airports. This phase was devoted to the definition of auxiliary agent/system requirements and to the review of existing knowledge on the performance of various agents and systems under particular fire and environmental conditions likely to be encountered at military airports. Where knowledge was lacking,

a series of environmental and small scale fire tests were conducted, the latter on three mockups simulating fires in an aircraft engine, fuel running along the incline of an aircraft wing and in a ruptured fuel tank containing reticulated foam. Author (GRA)

N73-18262# Environmental Health Lab., McClellan AFB, Calif.
NOISE ENVIRONMENTS OF CONTROL TOWERS Final Report

Robert A. Capell Jan. 1972 19 p
(AF Proj. NBF-133)

(AD-752535; EHL-M-72M-1) Avail: NTIS CSCL 13/2

Noise surveys were made at the control towers of two Air Force bases. Measurements of the indoor and outdoor sound pressure levels during aircraft take-offs and other operations were recorded. These data are presented so that an evaluation of the communication environments can be made by using certain operational data from each base. An evaluation of the noise attenuation provided by each tower is also made. Author (GRA)

N73-18263# Defense Documentation Center, Alexandria, Va.
LANDING FIELDS AND RUNWAYS, VOLUME 1 Report Bibliography, Jan. 1969 - Feb. 1972

Oct. 1972 169 p refs
(AD-751400; DDC-TAS-72-59-Vol-1) Avail: NTIS CSCL 01/5

The bibliography contains unclassified references on Landing Fields and Runways. These references deal with design, configuration, construction, pavement evaluation, rapid preparation sites, paints and coatings, composite materials, maintenance and repair of landing fields and runways. Four computer generated indexes are included. Author (GRA)

N73-18264# Vanderbilt Univ., Nashville, Tenn. Dept. of Mechanical Engineering.

ANALYSIS OF THE FLOW FIELD GENERATED NEAR AN AIRCRAFT ENGINE OPERATING IN REVERSE THRUST M.S. Thesis

Walter Andrew Ledwith, Jr. Aug. 1972 95 p refs
(Grant NGR-43-002-034)

(NASA-CR-121147) Avail: NTIS HC \$6.75 CSCL 20D

A computer solution is developed to the exhaust gas reingestion problem for aircraft operating in the reverse thrust mode on a crosswind-free runway. The computer program determines the location of the inlet flow pattern, whether the exhaust efflux lies within the inlet flow pattern or not, and if so, the approximate time before the reversed flow reaches the engine inlet. The program is written so that the user is free to select discrete runway speeds or to study the entire aircraft deceleration process for both the far field and cross-ingestion problems. While developed with STOL applications in mind, the solution is equally applicable to conventional designs. The inlet and reversed jet flow fields involved in the problem are assumed to be noninteracting. The nacelle model used in determining the inlet flow field is generated using an iterative solution to the Neuman problem from potential flow theory while the reversed jet flow field is adapted using an empirical correlation from the literature. Sample results obtained using the program are included. Author

N73-18269# Iowa State Univ. of Science and Technology, Ames.

NUMERICAL CALCULATION OF FLOW FIELDS ABOUT RECTANGULAR WINGS OF FINITE THICKNESS IN SUPERSONIC FLOW Ph.D. Thesis

Jerald Milo Vogel 1973 181 p refs.
(Grant NGR-16-002-029)

(NASA-CR-130985) Avail: NTIS HC \$11.25 CSCL 20D

The calculation of the outer inviscid flow about a rectangular wing moving at supersonic speeds is reported. The inviscid equations of motion governing the flow generated by the wing form a set of hyperbolic differential equations. The flow field about the rectangular wing is separated into three regions consisting of the forebody, the afterbody, and the wing wake. Solutions for the forebody are obtained using conical flow techniques while the afterbody and the wing wake regions are

treated as initial value problems. The numerical solutions are compared in the two dimensional regions with known exact solutions. Author

N73-18276# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany). Inst. fuer Luftstrahlantriebe.

CALCULATION OF PRESSURE DISTRIBUTION OF AEROFOILS IN CASCADES FOR TWO-DIMENSIONAL, INCOMPRESSIBLE FLOW WITH BOUNDARY-LAYER SEPARATION IN THE REGION OF TRAILING-EDGES

W. Geller 1972 121 p refs In GERMAN; ENGLISH summary (DLR-FB-72-62) Avail: NTIS HC \$8.25; DFVLR Porz-Wahn: 34.40 DM

A singularity method for calculating the flow through cascades with boundary layer separation is given. The contours of the blades are replaced by vortex sheets. Source distributions in the region of separation are used for simulating the displacement effect of separated wake. The source distributions are determined by satisfying the condition of constant static pressure on the blade contours in the full region between separation point on the upper and lower surface. The position of separation points is found by boundary layer calculation. As shown by comparison of theoretical and experimental results, calculated pressure distributions and flow deflection angles are generally well agreeing with measured data while the corresponding drag coefficients agree satisfactorily. Author

N73-18289# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

ON THE INVISCID ROLLED-UP STRUCTURE OF LIFT GENERATED VORTICES

Vernon J. Rossow Jan. 1973 22 p refs (NASA-TM-X-62224) Avail: NTIS HC \$3.25 CSCL 20D

A simple form is presented of the relationships for the inviscid, fully developed structure of lift-generated vortices behind aircraft wings. The method is then extended to arbitrary span-load distributions by inferring guidelines for the selection of rollup centers for the vortex sheet, along with rules for calculating the fully developed structure of the resulting multiple vortices. These techniques yield realistic estimates of the rolled-up structure of vortices produced by a wider variety of span-load distributions than possible with the original form of the theory. Author

N73-18293# Cambridge Univ. (England). Dept. of Engineering. **THE OFF-DESIGN ANALYSIS OF FLOW IN AXIAL COMPRESSORS**

H. Daneshyar and M. R. A. Shaalan London Aeron. Res. Council 1972 51 p refs Supersedes ARC-32727 (ARC-CP-1234; ARC-32727) Avail: NTIS HC \$4.75; HMSO 80 p; PHI \$3.55

The existence and uniqueness of the solutions obtained from the streamline curvature method of calculating flow through turbomachines are examined for several operating points of Rolls-Royce compressors. It is shown that under certain conditions the truncation errors in the numerical solution can become large and hence give rise to the violation of the uniqueness conditions. The computer program may then give wrong answers to the physical problem. The conditions for existence and uniqueness may be violated when the meridional velocities are small (e.g., near stall) or when there are regions of choked flow. Flow for an operating point in the stall region is computed by suitable modifications to minimize the truncation errors and hence to obtain a unique solution. This is compared with the results of the previously reported actuator disk theory and experiment. The effect of variation of losses on the calculation is examined together with the effect of a correction term due to a dissipative body force, which should be included in the momentum equation when losses are introduced. Author (ESRO)

N73-18297# California Inst. of Tech., Pasadena. **THE STRUCTURE OF TURBULENT LINE VORTICES**
P. G. Saffman 13 Oct. 1972 38 p refs
(Grant AF-AFOSR-2092-71; AF Proj. 9783)

(AD-753131; AFOSR-72-2283TR) Avail: NTIS CSCL 20/4

A theory is given to explain the observed dependence on Reynolds number of the decay of turbulent line vortices. The discussion considers first the self-similar vortex, in which all quantities are assumed to depend only on the circulation at infinity, the Reynolds number, and the time from a virtual origin. It is argued that the turbulent line vortex has a triple structure: an outer vortex of given radius, an inner vortex, and a viscous core. The axial velocity in the core, produced by growth of a trailing vortex shown to be Reynolds number dependent.

Author (GRA)

N73-18304# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

AN APPLICATION OF THE METHOD OF LINES TO THE TRANSONIC AIRFOIL PROBLEM M.S. Thesis

John Richard McCracken Dec. 1971 62 p refs

(AD-753390; GAM/AE/72-7) Avail: NTIS CSCL 20/4

The development and evaluation are presented of a numerical solution to the transonic airfoil problem. The scope is restricted to symmetrical airfoils at zero incidence angle in an inviscid flow field. The small perturbation relationship and the irrotationality condition are selected for the set of governing equations and the set is reduced to a system of ordinary differential equations by the method of lines. Solutions to this system are compared to experimental data on subcritical, critical, and supercritical airfoils and against the exact solutions to the subsonic and supersonic infinite wavy wall. GRA

N73-18305# Tennessee Technological Univ., Cookeville. Dept. of Engineering Science.

PRELIMINARY INVESTIGATION OF HIGH-VELOCITY LIQUID IMPACT DAMAGE

Ray Kinslow, Vireshwar Sahai, and John Peddieson, Jr. Dec. 1972 159 p refs

(Contract DAAH01-72-C-0375)

(AD-753381; TTU-ES-72-2) Avail: NTIS CSCL 11/6

The research reported has been directed toward an understanding of the mechanics of rain erosion of materials traveling at very high velocities. An analysis of the motion of raindrops in a hypersonic shock layer is described. A high-speed jet impingement analogy of the impact of liquid drops on solid surfaces is used to analytically determine the cavity profile. The effect of stress waves generated by liquid impact is discussed. It is shown that internal damage and spallation resulting from stress waves is often much greater than the material failure in the impact area itself. Experiments have demonstrated that water-drop impact can be closely simulated by the use of a high-speed water jet. Craters formed in the laboratory by the jet are compared with those of a radome surface after a led test in a rainfall.

Author (GRA)

N73-18319# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

FLOW FIELD ON THE LEE SIDE OF A DELTA WING M.S. Thesis

Robert Gene Christophel Dec. 1971 59 p refs

(AD-753389; GAM/AE/72-6) Avail: NTIS CSCL 20/4

A procedure is developed which utilizes the method of characteristics to solve a portion of the flow field on the lee side of a flat plate delta wing with supersonic leading edges at angle of attack but at zero yaw. The procedure requires input conditions of a free stream Mach number, an angle of attack and a sweep angle. The procedure is applied to three sets of input conditions and the resulting data are compared to published experimental and analytical data for the same set of input conditions. The comparisons indicate that the procedure may be useful in predicting the flow field in the pseudo-elliptic region and the position of the internal shock wave on the lee side of the wing. Author (GRA)

N73-18320# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

AN ANALYSIS OF THE FLOW FIELD AROUND A 2-D BODY

OF ARBITRARY SHAPE M.S. Thesis

Ellie B. Underwood, Jr. Dec. 1971 87 p refs
(AD-753387; GAM/AE/72-2) Avail: NTIS CSCL 20/4

An analytical study of the two-dimensional viscous, incompressible steady flow over an airfoil of arbitrary shape was made. Theodorsen's method was used to analyze the potential flow around the airfoil, providing edge velocities for the boundary layer equations, which were then solved by the Karman-Pohlhausen method. The resulting boundary layer displacement thickness was then added to the original airfoil shape to obtain a better potential flow solution. Iteration was continued in this manner until the desired accuracy was obtained. A computer program was written to effect this airfoil analysis technique.

GRA

N73-18439# Advisory Group for Aerospace Research and Development, Paris (France).

DISPLAYS FOR APPROACH AND LANDING OF V/STOL AIRCRAFT

Nov. 1972 17 p
(AGARD-AR-51) Avail: NTIS HC \$3.00 CSCL 01B

An analysis of the display systems required for approach and landing of V/STOL aircraft was conducted. The various factors considered in the analysis are: (1) operational factors and ground environment, (2) guidance requirements, (3) relation between control and display sophistication, (4) information requirements, (5) human factors engineering, and (6) current display devices. Diagrams of proposed instrument panels and display devices are included.

Author

N73-18464# Naval Air Development Center, Warminster, Pa. Air Vehicle Technology Dept.

EVALUATION OF THE -S/N- FATIGUE LIFE GAGE UNDER CONSTANT AND VARIABLE AMPLITUDE LOADING Final Report

Maurice S. Rosenfeld and Sidney Scheindlinger 5 Sep. 1972 141 p refs
(ZFX412)

(AD-753800; NADC-72071-VT) Avail: NTIS CSCL 01/3

An experimental program was conducted to evaluate the -S/N- Fatigue Life Gage and a number of gage installations was evaluated for constant and variable amplitude loading. The test results demonstrated that while there was a qualitative relation between gage resistance change and specimen life expended, a usable quantitative correlation was not attainable. Test results also proved that the fraction of specimen life to initial detectable crack was a better indicator of the time for retirement of a structure than was the fatigue life gage, although no estimate of the damage incurred can be obtained prior to crack detection.

Author (GRA)

N73-18491# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

GLUING ALUMINUM ALLOY PARTS (SELECTED PORTIONS)

22 Nov. 1972 24 p Transl. into ENGLISH from the monograph "Osnovy Konstruktsionnaya v Samoletostroenii" Moscow, 1971 p 171-184

(AD-753513; FTD-MT-24-1073-72) Avail: NTIS CSCL 13/8

Given are methods for designing and calculating typical elements of aircraft construction, such as beams, joint units, rivet, welded, glue and gluwelded connections. Taken into account are the basic requirements of aviation construction; namely, minimum weight and sufficient durability. Author (GRA)

N73-18584# Goodyear Aerospace Corp., Akron, Ohio.

DEVELOPMENT OF BALLISTIC-DAMAGE-TOLERANT FLIGHT CONTROL COMPONENTS MOLDED OF A SHORT-FIBER REINFORCED COMPOSITE MATERIAL. PHASE 1 SUMMARY REPORT: COMPOSITE MATERIAL FORMATION, EVALUATION, AND CHARACTERIZATION Summary Report, Jun. 1970 - Dec. 1971

Donald C. Cully, Robert V. Kolarik, T. J. Boller, and W. F. Conley
Sep. 1972 276 p refs

(Contract DAAJ02-70-C-0062; DA Proj. 1F1-62203-A-150)
(AD-752918; GER-15518; USAAMRD-TR-72-28) Avail: NTIS CSCL 11/9

The purpose of the program was to select and characterize the most efficient discontinuous fiber glass-epoxy composite for use in ballistically tolerant flight control components. The effects of various constituent parameters on the extent of damage and residual tensile load capacity were determined after tumbled caliber .30 ball M2 projectile impact at 0-degree obliquity and 1800 ft/sec. These parameters included fiber glass and resin types, interfacial properties, fiber length, and fiber content. The three most promising composites for further study were identified as 1-inch S-2 glass fibers in an epoxy novolac matrix, 1/2-inch S-2 glass fibers in an epoxy novolac matrix, and 1-inch E glass in a flexibilized epoxy matrix.

Author (GRA)

N73-18605# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

NUCLEAR THERMAL VULNERABILITY OF HONEYCOMB RADOME MATERIALS M.S. Thesis

Michael V. Bell Dec. 1972 86 p refs
(AD-753666; GNE/PH/73-1) Avail: NTIS CSCL 17/9

The thermal vulnerability levels of honeycomb sandwich radome panels were determined by using quartz iodide lamps to irradiate the panels in a wind tunnel the lamps and wind tunnel simulated a thermal pulse on a flying aircraft. The radome panels were tested with lampblack, neoprene, and polyurethane coatings. Peak flux and 94.3 cal/sq cm total fluence.

Author

N73-18655# Nevada Univ., Reno. Lab. of Atmospheric Physics. DESIGN AND CONSTRUCTION OF A NEW CLOUD PARTICLE REPLICATOR FOR USE ON A PRESSURIZED AIRCRAFT Final Report, 18 May 1970 - 29 Feb. 1972

John Hallett, Richard W. Hanaway, and Peter B. Wagner 31 May 1972 44 p refs

(Contract F19628-70-C-0279)

(AD-753091; AFCRL-72-0410) Avail: NTIS CSCL 04/2

A continuous particle replicator for cloud drops and ice crystals has been constructed for use on a pressurized aircraft, the C130 of Air Force Systems Command, Hanscom Field. A design is described which has the following capabilities: produces a uniform replica over a wide range of aircraft operating conditions; gives eight speeds of film transport enabling the particle concentration on the film to be adjusted depending on the concentration in the cloud and flight speed; gives inflight viewing of the replica; and enables the film to be stopped and started in flight. Preliminary flight results show that at air speeds around 100 m/sec crystals smaller than 100 micrometers and drops smaller than 40 micrometers are replicated without serious problems, larger particles break up or shatter, although larger ice crystals, up to several mm, may still be identified.

Author (GRA)

N73-18661# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.

HELICOPTER DOWNWASH APPLIED TO FOG CLEARING: A STATUS SUMMARY

Walter S. Nordquist, Jr. and David H. Dickson Oct. 1972 53 p refs

(DA Proj. 1TO-61102-B-53A)

(AD-753357; ECOM-5465) Avail: NTIS CSCL 04/2

The report summarizes the results of a literature search and a survey of helicopter pilots concerning the use of helicopter-induced downwash to effect temporary clearings in fog. While the technique has been unsuccessfully applied in a variety of situations, the available information indicates that the criteria for determining the probability of successful application of this method is yet to be completely established. In general larger helicopters, such as the CH-54, can be successfully used for clearing fogs of 500-600 foot depth; however, smaller helicopters, such as the UN-1, do not work well for fogs of depths over 100-300 feet.

Author (GRA)

N73-18664# National Aviation Facilities Experimental Center, Atlantic City, N.J.
TACAN-DME FALSE DISTANCE LOCK-ON Final Report, Aug. 1971 - Jul. 1972

George Hartranft, Matthew Naimo, and Harold Postel Feb. 1973 63 p

(FAA Proj. 041-306-05X)

(FAA-NA-72-65; FAA-RD-72-98) Avail: NTIS HC \$5.25

The results of laboratory and field tests of various Tacan ground station modifications designed to minimize the false DME problem are presented. An airborne and ground data collection package was designed to record the percentage of false replies synchronous with an aircraft interrogation. The modifications tested included a modified GRN-9 Tacan receiver, a tighter decoder tolerance modification, a jittering dead time gate, and a retriggerable long dead time gate. Although all modifications were successful in reducing the percentage of false DME, the retriggerable long dead time gate modification was the most successful in eliminating all false DME caused by multipath air-to-ground interrogations.

Author

N73-18704*# Massachusetts Inst. of Tech., Cambridge, Dept. of Aeronautics and Astronautics.

A SYSTEMATIC STUDY OF SUPERSONIC JET NOISE Final Report

Jean F. Louis Dec. 1971 74 p refs

(Grant NGL-22-009-383; Contract DOT-TSC-142)

(NASA-CR-130964; DOT-TSC-142-1; PB-211954) Avail: NTIS HC \$5.75 CSCL 21E

Acoustic fields associated with two different nozzle configurations, a rectangular and a circular, are studied. Both nozzles were designed with the same exit Mach number and have an identical momentum and energy flux. So far tests have been made in the range of 1000-5000 degrees R. for different levels of expansion and an exit Mach number of 2.7. In comparing the two nozzles, it is found that the rectangular nozzle is indeed quieter than the circular nozzle.

Author (GRA)

N73-18706# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.

A METHOD TO COMPARE THE POTENTIAL OF A FLOWING LIQUID HYDROCARBON TO GENERATE STATIC ELECTRICITY M.S. Thesis

Valentine L. Denninger Jun. 1972 81 p refs

(AD-753386; GA/ME/72-4) Avail: NTIS CSCL 20/3

The study examines static charge generation in hydrocarbon fuels during flow through pipes. Particular emphasis is placed on the effect of linear velocity, pipe diameter and length, and the liquid solid interface. A parameter was developed which may be of use to system designers as a basis for comparing static electric charge generating characteristics of various fuel-container material combinations. Laboratory scale apparatus for the measurement of conductivity and charge density in the flowing fluid was designed, constructed and instrumented. A by product of this work was the development of a fully guarded parallel plate conductivity cell which indicates some improvement over other designs.

GRA

N73-18798# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Luftsaugende Antrieb.

THE RECIRCULATION FLOW PATTERN OF A VTOL LIFT ENGINE

E. Schwantes 1972 165 p refs In GERMAN; ENGLISH summary

(DLR-FB-72-50) Avail: NTIS HC \$10.25; DFVLR Porz-Wahn: 29 DM

A method is presented to predict theoretically the increase of temperature due to wind-recirculation in the inlet of a VTOL lift engine exhausting normally to the ground. It is shown how to calculate with the potential-theory the velocities in the recirculation flow and how to determine the temperatures with the laws of spread of buoyant plumes. Many model-investigations are done to check these results. During this, the three regions of a VTOL propulsion jet, the free jet, the wall jet, and the zone of separation of the wall jet from the ground, due to wind

effects and buoyancy forces are investigated at model-jets with critical nozzle pressure ratio and temperatures up to 1000 C.

Author

N73-18799# National Aerospace Lab., Tokyo (Japan).

DIGITAL CONTROL OF JET ENGINES. 1: CONTROL SYSTEM AND PRELIMINARY EXPERIMENTS

Kenji Nishio, Masanori Endo, Nanahisa Giyama, Takeshi Koshinuma, Toshimi Hata, Yukio Matsuda, Akira Yoshida, and Susumu Nakayama 1972 60 p refs In JAPANESE; ENGLISH summary

(NAL-TR-281) Avail: NTIS HC \$5.00

The application of integrated circuit technology to the electronic control of jet engines is discussed. The analog and digital types of control systems are compared on the basis of flexibility, reliability, manufacturing costs, and producibility. The software and hardware involved in a jet engine control system using a digital computer are described.

Author

N73-18803*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

ANALYTICAL AND EXPERIMENTAL PERFORMANCE OF OPTIMAL CONTROLLER DESIGNS FOR A SUPERSONIC INLET

John R. Zeller, Bruce Lehtinen, Lucille C. Geyser, and Peter G. Batterton Washington Mar. 1973 87 p refs

(NASA-TN-D-7188; E-7173) Avail: NTIS HC \$3.00 CSCL 20D

The techniques of modern optimal control theory were applied to the design of a control system for a supersonic inlet. The inlet control problem was approached as a linear stochastic optimal control problem using as the performance index the expected frequency of unstarts. The details of the formulation of the stochastic inlet control problem are presented. The computational procedures required to obtain optimal controller designs are discussed, and the analytically predicted performance of controllers designed for several different inlet conditions is tabulated. The experimental implementation of the optimal control laws is described, and the experimental results obtained in a supersonic wind tunnel are presented. The control laws were implemented with analog and digital computers. Comparisons are made between the experimental and analytically predicted performance results. Comparisons are also made between the results obtained with continuous analog computer controllers and discrete digital computer versions.

Author

N73-18804# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).

THE SUPERSONIC COMPRESSOR RESEARCH AT THE VON KARMAN INSTITUTE FOR FLUID DYNAMICS

Frans A. E. Breugelmans Jun. 1972 46 p refs

(Grant AF-AFOSR-2104-71; AF Proj. 7065)

(AD-752583; ARL-72-0179) Avail: NTIS CSCL 21/5

The basic principles of the supersonic cascade and wheel are described. A series of blade profiles and supersonic wheels developed at the VKI are discussed and the progress due to the research effort is emphasized.

Author (GRA)

N73-18805# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).

THE LOW HUB-TIP RATIO SUPERSONIC AXIAL-FLOW COMPRESSOR, VOLUME 1 Final Report, 1 Jul. 1971 - 30 Jun. 1972

Frans A. E. Breugelmans Jun. 1972 52 p refs

(Grant AF-AFOSR-2104-71; AF Proj. 7065)

(AD-752585; VKI-IN-40-Vol-1; ARL-72-0180) Avail: NTIS CSCL 21/5

The report describes the test results of a supersonic axial flow compressor stage with a tip Mach number of 2.0. Volume I discusses especially the inlet stall, the associated flow field and the stage performance. Methods are proposed to eliminate the stall problem.

Author (GRA)

N73-18806# Naval Air Propulsion Test Center, Trenton, N.J. Propulsion Technology and Project Engineering Dept.

STATE-OF-THE-ART REVIEW OF TURBINE ENGINE INLET

NOISE Final Technical Report

Robert B. Benham Nov. 1972 160 p refs
(AD-753000; NAPTC-PE-6) Avail: NTIS CSCL 21/5

The report points out that turbine-type engine design is evolving in a direction which will make fan and compressor turbomachinery noise continually more obtrusive. The TF34 engine is representative of state-of-the-art high bypass ratio subsonic turbofan technology. It contains no inlet noise-suppression design and the inlet noise exceeds Federal Air Regulation Part 36 take-off sideline noise limits by about 6PNdb. There are descriptions and theoretical presentations explaining the principal mechanisms producing the three inlet noise contributors; interaction tones, combination tones, and broadband radiation. It is shown that noise control can be affected either at the rotor-stator source or with nacelle installation attenuation. Author (GRA)

N73-18809# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.,
GAS-DYNAMIC VERIFICATION CALCULATION OF AXIAL FLOW MULTISTAGE COMPRESSORS ON EDC

A. P. Tunakov and S. G. Ibragimov 1 Nov. 1972 22 p refs
Transl. into ENGLISH from Tr. Aviats. Inst. (Kazan); no. 114, 1970 p 31-47

(AD-753519; FTD-MT-24-1501-72) Avail: NTIS CSCL 21/5
An algorithm for testing the gas dynamic design of axial-flow compressors, particularly in the final adjustment phase, is proposed. Particularly well suited for calculating the parameters of blade rings, the procedure is suitable for use in the design phase if data on the loss coefficients in empirical formulas have been established. Author (GRA)

N73-18890* Kaman Aerospace Corp., Bloomfield, Conn.
A FLYING EJECTION SEAT

R. H. Hollrock and J. J. Barzda /n NASA. Lyndon B. Johnson Space Center The 7th Aerospace Mech. Symp. Nov. 1972 p 275-286
CSCL 06G

To increase aircrewmembers' chances for safe rescue in combat zones, the armed forces are investigating advanced escape and rescue concepts that will provide independent flight after ejection and thus reduce the risk of capture. One of the candidate concepts is discussed; namely, a stowable autogyro that serves as the crewman's seat during normal operations and automatically converts to a flight vehicle after ejection. Discussed are (1) the mechanism subsystems that the concept embodies to meet the weight and cockpit-packaging constraints and (2) tests that demonstrated the technical feasibility of the stowage, deployment, and flight operation of the rotor lift system. Author

N73-18935# Stuttgart Univ. (West Germany). Inst. fuer Statik und Dynamik der Luft- und Raumfahrtkonstruktionen.
CONSTRUCTION, SCOPE AND USE OF THE TEST FACILITIES AT THE ISD Final Report [AUFBAU, UMFANG UND ANWENDUNG DER VERSUCHSANLAGEN IM ISD]

John H. Argyris, Werner Aicher, Klaus Eberle, and Wolfram Haug Feb. 1972 57 p refs In GERMAN; ENGLISH summary
(Contract RFF-4019)
(ISD-119) Avail: NTIS HC \$5.00

Computational methods for accurate determination of the behavior of engineering structures, including deformations, dynamic response, ultimate load, and service life are described. These methods take advantage of modern computers. The methods have been applied to structures in all fields of engineering. Large scale structural tests and experimental material investigations are required for further development of analytical methods. Author (ESRO)

N73-18960* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PERFORMANCE GAINS BY USING HEATED NATURAL-GAS FUEL IN AN ANNULAR TURBOJET COMBUSTOR

Nicholas R. Marchionna Washington Mar. 1973 20 p refs
(NASA-TM-X-2742; E-7236) Avail: NTIS HC \$3.00 CSCL

21E

A full-scale annular turbojet combustor was tested with natural gas fuel heated from ambient temperature to 800 K (980 F). In all tests, heating the fuel improved combustion efficiency. Two sets of gaseous fuel nozzles were tested. Combustion instabilities occurred with one set of nozzles at two conditions: one where the efficiency approached 100 percent with the heated fuel; the other where the efficiency was very poor with the unheated fuel. The second set of nozzles exhibited no combustion instability. Altitude relight tests with the second set showed that relight was improved and was achievable at essentially the same condition as blowout when the fuel temperature was 800 K (980 F).

Author

N73-18975# Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio.

ASSESSMENT OF POLLUTANT MEASUREMENT AND CONTROL GOALS FOR MILITARY AIRCRAFT ENGINES

William S. Blazowski and Robert E. Henderson Nov. 1972 72 p refs
(AF Proj. 3048; AF Proj. 3066)

(AD-753095; AFAPL-TR-72-102) Avail: NTIS CSCL 13/2

The problem of mass emissions from aircraft gas turbine engines is briefly reviewed and the aspects of this problem which are unique to military aircraft operation are discussed. Pollutant measurement technology and the existing data base are summarized and candidate control techniques are identified. Proposed Environmental Protection Agency regulations for aircraft engine emissions are examined in terms of their impact on and application to military engines. It is concluded that the special considerations, both performance and otherwise, which must be afforded to military aircraft prohibit direct application of the EPA regulations. The report concerns Air Force emission limitation goals established in light of these efforts. Maximum allowable idle combustion inefficiency, oxide of nitrogen emission (1bm/1000 lbm fuel), and smoke number are specified. The rationale behind using these parameters, and the means by which the numerical goals were derived are discussed. Author (GRA)

N73-18978* Tracor, Inc., Austin, Tex.

EVALUATION OF NOISE POLLUTION LEVEL BASED UPON COMMUNITY EXPOSURE AND RESPONSE DATA

Richard D. Edmiston 1 Dec. 1972 114 p refs

(Contract NASw-2304; TRACOR Proj. 076-166)

(NASA-CR-130920; T-72-AU-9086-U) Avail: NTIS HC \$7.75
CSCL 05K

The results and procedures are reported from an evaluation of noise pollution level as a predictor of annoyance, based on aircraft noise exposure and community response data. The measures of noise exposure presented include composite noise rating, noise exposure forecast, noise and number index. A proposed measure as a universal noise exposure measure for noise pollution level (L sub NP) is discussed. F.O.S.

N73-18981* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

AIR-CUSHION TANKERS FOR ALASKAN NORTH SLOPE OIL

John L. Anderson Washington Mar. 1973 30 p refs

(NASA-TM-X-2683; E-7210) Avail: NTIS HC \$3.00 CSCL 01C

A concept is described for transporting oil from the Arctic to southern markets in 10,000-ton, chemically fueled air-cushion vehicles (ACV's) configured as tankers. Based on preliminary cost estimates the conceptual ACV tanker system as tailored to the transportation of Alaskan North Slope oil could deliver the oil for about the same price per barrel as the proposed trans-Alaska pipeline with only one-third of the capital investment. The report includes the description of the conceptual system and its operation; preliminary cost estimates; an appraisal of ACV tanker development; and a comparison of system costs, versatility, vulnerability, and ecological effect with those of the trans-Alaska pipeline. Author

N73-18983# Aviation Advisory Commission, Washington, D.C.
THE LONG RANGE NEEDS OF AVIATION: TECHNICAL
ANNEX TO THE REPORT OF THE AVIATION ADVISORY
COMMISSION, VOLUME 1

Jan. 1973 598 p refs 2 Vol.

(PB-215803) Avail: NTIS HC \$12.50

The findings and recommendations of the Aviation Advisory Commission are presented. In the process of arriving at these findings and recommendations, the Commission took into consideration, among other things, an extensive body of information developed for it by its staff, consultants, contractors, and many informed and concerned persons who communicated directly with the Commission or participated in discussions and conferences sponsored by the Commission on matters of particular interest. The purpose of this technical annex is to provide, for those interested in the additional depth and detail of the foundation underlying the Commission's studies, the more significant background material developed by the various sources of information. Author

N73-18984# Aviation Advisory Commission, Washington, D.C.
THE LONG RANGE NEEDS OF AVIATION: TECHNICAL
ANNEX TO THE REPORT OF THE AVIATION ADVISORY
COMMISSION, VOLUME 2

Jan. 1973 471 p refs 2 Vol.

(PB-215804) Avail: NTIS HC \$10.60

Special issues and problems involved in the long range needs of aviation are analyzed. The subjects discussed are (1) noise problems created by aircraft operation, (2) air service to small and isolated communities, (3) general aviation requirements, and (4) financial aspects of the aerospace industry. P.N.F.

N73-18994# Aeronautical Research Labs., Melbourne (Australia).
THE AERODYNAMIC BEHAVIOUR OF A TWO-
DIMENSIONAL AEROFOIL FITTED WITH SEMICIRCULAR
AND SQUARE BLUNT BASES AT MACH NUMBERS UP
TO 1.20

N. Pollock Jun. 1972 28 p refs Original contains color illustrations

(ARL/A-Note-336) Avail: NTIS HC \$3.50

Transonic wind tunnel tests on a two-dimensional airfoil fitted with square and convex semi-circular blunt bases have been conducted over Mach number range of 0.5 to 1.2 at a base height Reynolds number of $4.2 \times 1,000$. A drag comparison showed that the semi-circular base had equal or greater drag than the square base in the range 0.5 to 0.96 and less drag in the range 0.96 to 1.20. At sonic speed the drag advantage of the semi-circular base reached 20 percent. Schlieren observations of the vortex shedding from the semi-circular base showed a number of acoustic resonances and some unusual photographs illustrating this phenomena are included. Author

N73-18995*# United Aircraft Corp., Stratford, Conn. Sikorsky
Aircraft Div.

WIND TUNNEL SIMULATION OF FULL SCALE VORTICES

James B. Rorke and Robert C. Moffitt Washington NASA Mar. 1973 115 p refs

(Contract NAS1-10446)

(NASA-CR-2180) Avail: NTIS HC \$3.00 CSCL 01A

An experimental investigation has been conducted to determine the important scaling parameters for the flow in the core region of a vortex generated by a rectangular wing tip. The effect of an unconventional planform, the ogee tip, on the tip vortex is also determined. For rectangular planform wings, the measured vortex core diameter to chord ratios, peak tangential velocity ratios, and axial velocity ratios are shown to be functions only of wing lift coefficient and elapsed time from vortex formation, and appear to be independent of both Mach number and Reynolds number. The peak tangential velocities in the diffuse vortex generated by the ogee tip are only 25 percent of those in the vortex generated by the rectangular wing. Author

N73-18996*# United Aircraft Corp., Stratford, Conn. Sikorsky
Aircraft Div.

ANALYSIS OF HELICOPTER MANEUVER-LOADS AND
ROTOR-LOADS FLIGHT TEST DATA

Edward A. Beno Washington NASA Mar. 1973 94 p refs

(Contract NAS1-11049)

(NASA-CR-2225) Avail: NTIS HC \$3.00 CSCL 01C

A study was conducted in which available airload and blade response data for the NH-3A and CH-53A rotors were analyzed in an attempt to provide greater insight into the sources of rotor vibratory loads in both level and maneuvering flight. Primary emphasis in the study was placed on examining and understanding causes of high-frequency rotor control loads. Secondary objectives were: (1) to examine the effect of number of rotor blades on hub vibratory shear forces and (2) to assess which of the many terms appearing in the hub vibratory shear force expression were of most significance. Author

N73-18999# National Gas Turbine Establishment, Farnborough
(England).

ON THE SUB-CRITICAL STABILITY OF VARIABLE RAMP
INTAKES AT MACH NUMBERS AROUND 2

S. A. Fisher, M. C. Neal, and A. J. Brooks London Aeron. Res. Council 1972 38 p refs Supersedes NGTE-R311; ARC-32910

(ARC-R/M-3711; NGTE-R311; ARC-32910) Avail: NTIS HC \$4.00; HMSO £1.38; PHI \$5.80

The need to minimize the pre-entry drag of supersonic intakes is discussed with particular emphasis on the shock pattern in the region of the cowl lip and aerodynamic instability resulting from shear zones generated in the supersonic compression field entering the subsonic diffuser. Observations of flow instabilities made under experimental conditions are described to show instability in variable ramp intakes at Mach numbers of about 2. The two forms of instability observed in the tests are analyzed. A design technique is suggested which offers the prospect of achieving minimum pre-entry drag with freedom from instabilities induced by shear zones. Author (ESRO)

N73-19000# Loughborough Univ. of Technology (England). Dept.
of Transport Technology.

A REVIEW OF WIND TUNNEL TESTS ON CIRCULATION
CONTROL DEVICES FOR AIRCRAFT CONTROL

F. G. Maccabee, B. R. Hilton, and J. I. Marsh London Aeron. Res. Council 1972 87 p refs Supersedes ARC-33456; TT-71-R-04

(ARC-CP-1232; ARC-33456; TT-71-R-04) Avail: NTIS HC \$6.50; HMSO £1.35; PHI \$5.30

The results of wind tunnel tests made during 1968-1971 in an experimental study of blowing applied to sections of circular cylinders are reviewed. The study was aimed at exploring the possibility of producing aircraft controlling and braking forces at low speeds. Various aspect ratios and blowing arrangements were examined, including the use of two cylinders producing mutual interference effects. ESRO

N73-19003# Aerospace Research Labs., Wright-Patterson AFB,
Ohio.

EFFECT OF TWO DIMENSIONAL SUCTION FLOWS INTO
DOUBLE INTAKES ON THE UPPER SURFACE OF A
JOUKOWSKI AIRFOIL

K. S. Nagaraja Nov. 1972 25 p refs

(Contract AF Proj. 7064)

(AD-754208; ARL-72-0146) Avail: NTIS CSCL 20/4

Fan-in-wing type vertical take-off and landing aircraft are under investigation in the development cycle of new classes of aircraft for military and civilian missions. In view of inadequate theoretical and experimental information available, some preliminary analyses of two-dimensional problems are explored. The effect of suction flow alone on the aerodynamic characteristics of an airfoil exhibit certain novel features such as invalidation of Kutta condition for high values of intake to free stream velocity ratio. With a view to understand the flow characteristics when two intakes are located on the upper surface of a Joukowski airfoil, the two-dimensional potential flow theory is applied. Author (GRA)

N73-19004* National Aeronautics and Space Administration,
Washington, D.C.

AIRCRAFT CONTROL SYSTEM Patent

Paul S. Rempfer, Alan J. Robertson, Lloyd E. Stevenson, and Joseph S. Kozioł, Jr., inventors (to NASA) Issued 16 Jan. 1973 8 p Filed 13 Jul. 1970 Supersedes N70-36052 (08 - 19, p 3471)

(NASA-Case-ERC-10439; US-Patent-3,711,042; US-Patent-Appl-SN-54271; US-Patent-Class-244-77D; US-Patent-Class-244-17.13; US-Patent-Class-318-489) Avail: US Patent Office CSCL 01C

An aircraft control system is described which is particularly suited to rotary wing aircraft. Longitudinal acceleration and course rate commands are derived from a manual control stick to control translational velocity of the aircraft along a flight path. In the collective channel the manual controls provide vertical velocity commands. In the yaw channel the manual controls provide sideslip or heading rate commands at high or low airspeeds, respectively. The control system permits pilots to fly along prescribed flight paths in a precise manner with relatively low work load. Official Gazette of the U.S. Patent Office

N73-19005# Deutsche Gesellschaft fuer Luft- und Raumfahrt, Cologne (West Germany).

REPORT ON THE THIRD MEETING OF THE DGLR-SYMPOSIUM, FLIGHT TESTING TECHNOLOGY: RELIABILITY OF RESULTS DERIVED FROM SIMULATION IN COMPARISON WITH RESULTS OF ACTUAL FLIGHT Oct. 1972 98 p refs Meeting held at Bremen, 28 Apr. 1972 (DLR-Mitt-72-18) Avail: NTIS HC \$7.00; ZLDI Munich: 20,80 DM

The proceedings of a conference on flight testing technology are presented. The theme of the conference was the reliability of the results derived from flight simulators as compared with the results of actual flight tests. The subjects discussed are: (1) simulation and flight test of automatic STOL landing, (2) precision of aerodynamic coefficients for flight simulation, (3) selected problems for constructing simulation models, (4) the reliability of results obtained by captive tests, and (5) the influence of the methods of flight test and simulation on the reliability of simulation results.

N73-19006 Bodenseewerk Geraetetechnik G.m.b.H., Ueberlingen (West Germany).

COMPARISON OF SIMULATION AND FLIGHT TEST FOR AUTOMATIC STOL LANDINGS [VERGLEICH VON SIMULATION UND FLUGVERSUCH BEI AUTOMATISCHEN STOL-LANDUNGEN]

H. Boehret /in DGLR Rept. on the 3d Meeting of the DGLR-Symp., Flight Testing Technol. Oct. 1972 p 7-28 In GERMAN

The comparison of simulation and flight test results for automatic STOL landings is presented. The subjects discussed are: (1) description of flight control system, (2) control of flight path during approach, (3) control of aerodynamic flow conditions, (4) description of simulator, (5) influence of nonlinearity, and (6) application of radar for altitude measurement. Author

N73-19007 Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).

OBSERVATIONS ON THE VALIDITY OF SIMULATION STUDY RESULTS IN COMPARISON WITH RESULTS FROM REAL FLIGHT TESTS [BETRACHTUNGEN ZUR GUELTIGKEIT VON ERGEBNISSEN AUS SIMULATIONSUNTERSUCHUNGEN IM VERGLEICH ZU DEN ERGEBNISSEN ECHTER FLUGVERSUCHE]

U. Schulz and H. Seelmann /in DGLR Rept. on the 3d Meeting of the DGLR-Symp., Flight Testing Technol. Oct. 1972 p 29-52 refs In GERMAN

A comparison of the validity of results obtained by flight simulation with results obtained from actual flight tests is presented. The background for the development of the simulator is discussed. The techniques for conducting the simulation are outlined. Examples of flight simulation operations are developed. Results of the comparison indicate good correlation between simulation and flight test data. Author

N73-19008 Vereinigte Flugtechnische Werke-Fokker G.m.b.H., Bremen (West Germany).

ON THE ACCURACY OF AERODYNAMIC PARAMETERS FOR SIMULATION [UEBER DIE GENAUIGKEIT DER AERODYNAMISCHEN BEIWERTE FUER DIE SIMULATION] B. Haftmann /in DGLR Rept. on the 3d Meeting of the DGLR-Symp., Flight Testing Technol. Oct. 1972 p 53-66 In GERMAN

The procedure for developing the aerodynamic parameters for use in flight simulator research projects is described. Emphasis is placed on wind tunnel measurements to determine aerodynamic coefficients. Sources of error in wind tunnel measurements are analyzed. Procedures for compensating for errors arising during wind tunnel tests are explained. Results of a typical investigation are presented as graphs. Author

N73-19009 Vereinigte Flugtechnische Werke-Fokker G.m.b.H., Bremen (West Germany).

SELECTED PROBLEMS OF SIMULATION MODEL FUNCTION [AUSGEWAELTE PROBLEME DER BILDUNG VON SIMULATIONSMODELLEN]

K. H. Unterreiner /in DGLR Rept. on the 3d Meeting of the DGLR-Symp., Flight Testing Technol. Oct. 1972 p 67-78 In GERMAN

Selected problems in the formation of simulation models are presented. The construction of a flight control system for a V/STOL aircraft simulator is used as the example. Sources of errors in the construction of the system are explained. Diagrams of typical systems are provided. Graphs of response curves and a table of performance data are included. Author

N73-19010 Vereinigte Flugtechnische Werke-Fokker G.m.b.H., Bremen (West Germany).

ON THE RELIABILITY OF DORN TEST RESULTS FOR FREE FLIGHT TESTS [UEBER DIE VERLAEBLICHKEIT VON ERGEBNISSEN AUS DEM DORNVERSUCH FUER FREIFLUGVERSUCHE]

H. Goerlich /in DGLR Rept. on the 3d Meeting of the DGLR-Symp., Flight Testing Technol. Oct. 1972 p 79-92 In GERMAN

The determination of aerodynamic characteristics of aircraft while mounted on a fixed column is discussed. The construction of the test equipment to measure pitching and rolling moments is described. The advantages of using such a method as a complement to flight tests are outlined. Specific examples of tests conducted and the results obtained during captive tests are analyzed. Author

N73-19011 Vereinigte Flugtechnische Werke-Fokker G.m.b.H., Bremen (West Germany).

THE EFFECT OF SIMULATION RESULT RELIABILITY ON FLIGHT TEST AND SIMULATION METHODOLOGY [ZUM EINFLUSS DE VERLAESSLICHKEIT DER SIMULATIONS-RESULTATE AUF DIE METHODIK VON FLUGVERSUCH UND SIMULATION]

R. Kaestner /in DGLR Rept. of the 3d Meeting of the DGLR-Symp., Flight Testing Technol. Oct. 1972 p 93-99 In GERMAN

Various methods of flight simulation are described and a comparison of the results obtained by flight simulators with flight tests are discussed. The VAK 191B aircraft is used as an example of typical takeoff and landing performance for STOL aircraft. Diagrams of the aircraft attitude control during transition phases following takeoff and during land approach are provided. Techniques used by the test pilot in conducting the flight tests are described. Author

N73-19012# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

A SUMMARY OF WIND TUNNEL RESEARCH ON TILT ROTORS FROM HOVER TO CRUISE FLIGHT

Philippe Poisson-Quinton (ONERA) and Woodrow L. Cook Paris ONERA 1972 18 p refs (NASA-TM-X-68948; ONERA-TP-1133) Avail: NTIS HC \$3.00 CSCL 01C

An experimental research program has been conducted on

a series of tilt rotors designed for a range of blade twist in various wind tunnel facilities. The objective was to obtain precise results on the influence of blade twist and aeroelasticity on tilt rotor performance, from hover to high speed cruise Mach number of about 0.7, global forces on the rotor, local loads and blade torsional deflection measurements were compared with theoretical predictions inside a large Reynolds-Mach envelope. Testing techniques developed during the program are described. Author

N73-19013* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

TERMINAL-AREA STOL OPERATING SYSTEMS EXPERIMENTS PROGRAM

Donald W. Smith, DeLamar Watson, and Jay V. Christensen
Feb. 1973 11 p ref
(NASA-TM-X-62235) Avail: NTIS HC \$3.00 CSCL 01C

Information which will aid in the choice by the U.S. Government and industry of system concepts, design criteria, operating procedures for STOL aircraft and STOL ports, STOL landing guidance systems, air traffic control systems, and airborne avionics and flight control systems. Ames has developed a terminal-area STOL operating systems experiments program which is a part of the joint DOT/NASA effort is discussed. The Ames operating systems experiments program, its objectives, the program approach, the program schedule, typical experiments, the research facilities to be used, and the program status are described. Author

N73-19014* Linguistic Systems, Inc., Cambridge, Mass.
PREDICTION OF HELICOPTER ROTOR LOADS

J. Gallot Washington NASA Mar. 1973 18 p refs Transl. into ENGLISH of the preprint "Calcul des Charges sur Rotor d'Helicoptere" Aerospatiale, Div. Helicopters, Etablissement de Marignane, Marseille, 1972 p 3.1 - 3.8
(Contract NASw-2482)

(NASA-TT-F-14845) Avail: NTIS HC \$3.00 CSCL 01C

The correct design of a rotor requires a precise knowledge of the alternating loads to which blade and hub are submitted. The problem of the stress evaluation, from the early design stage, may lead to very sophisticated methods, because the blade is operating in a very complex environment. Nevertheless simplified methods may give sufficiently precise results to set up correctly the dimensions of the main elements of the rotor. The method described supposes simple aerodynamics, independent of blade elastic deformations. The degree of simplification achieved in this theoretical method seems to be justified by the correlation obtained with experimental airloads measured on a model rotor at the Modane Wind Tunnel, and stresses recorded on the same rotor, or a full-scale semi-articulated rotor. Author

N73-19015 National Transportation Safety Board, Washington, D.C.

SPECIAL STUDY: ACCIDENTS INVOLVING ENGINE FAILURE/MALFUNCTION US GENERAL-AVIATION 1965-1969

29 Nov. 1972 220 p
(NTSB-AAS-72-10) Avail: NTIS HC \$13.00

The record of engine failure/malfunction accidents for fixed-wing aircraft which occurred in all operations of U.S. General Aviation during the period 1965-1969 is presented. It includes a comparison of the engine-failure accident rates for single-engine and multi-engine aircraft. Analyses are included concerning causes and related factors of engine-failure accidents by selected makes and models of aircraft and engines. Injury tables, analytic tables, and cause/factor tables are presented for all fixed-wing aircraft along with single-engine and multi-engine fixed-wing aircraft. Author

N73-19016* Astro Research Corp., Santa Barbara, Calif.
GROUND AND FLIGHT TEST PROGRAM OF A STOKES-FLOW PARACHUTE: PACKAGING, DEPLOYMENT, AND SOUNDING ROCKET INTEGRATION Final Report

P. G. Niederer and D. J. Mihora 27 Sep. 1972 86 p refs
(Contract NAS1-10947)
(NASA-CR-112251) Avail: NTIS HC \$6.50 CSCL 01C

The current design and hardware components of the patented 14 sqm Stokes flow parachute are described. The Stokes-flow parachute is a canopy of open mesh material, which is kept deployed by braces. Because of the light weight of its mesh material, and the high drag on its mesh elements when they operate in the Stokes-flow flight regime, this parachute has an extremely low ballistic coefficient. It provides a stable aerodynamic platform superior to conventional nonporous billowed parachutes, is exceptionally packable, and is easily contained within the canister of the Sidewinder Arcas or the RDT and E rockets. Thus, it offers the potential for gathering more meteorological data, especially at high altitudes, than conventional billowed parachutes. Methods for packaging the parachute are also recommended. These methods include schemes for folding the canopy and for automatically releasing the pressurizing fluid as the packaged parachute unfolds. Author

N73-19017* Aerospace Corp., El Segundo, Calif.

STUDY OF V/STOL AIRCRAFT IMPLEMENTATION. VOLUME 1: SUMMARY

W. J. Portenier and H. M. Webb Washington NASA Mar. 1973 89 p refs
(Contract NAS2-6473)

(NASA-CR-2227) Avail: NTIS HC \$3.00 CSCL 01C

A high density short haul air market which by 1980 is large enough to support the introduction of an independent short haul air transportation system is discussed. This system will complement the existing air transportation system and will provide relief of noise and congestion problems at conventional airports. The study has found that new aircraft, exploiting V/STOL and quiet engine technology, can be available for implementing these new services, and they can operate from existing reliever and general aviation airports. The study has also found that the major funding requirements for implementing new short haul services could be borne by private capital, and that the government funding requirement would be minimal and/or recovered through the airline ticket tax. In addition, a suitable new short haul aircraft would have a market potential for \$3.5 billion in foreign sales. The long lead times needed for aircraft and engine technology development will require timely actions by federal agencies. Author

N73-19018* General Electric Co., Cincinnati, Ohio.

REMOTE LIFT FAN STUDY PROGRAM, VOLUME 1

Aug. 1972 47 p refs

(Contract NAS3-14408)

(NASA-CR-120970-Vol-1; R72AEG242-Vol-1) Avail: NTIS HC \$4.50 CSCL 01C

A summary of the concepts for achieving low noise levels for future V/STOL aircraft is presented. The combined system noise for 12 lift fan units operating at 10,000 lbs of lift (each) was not to exceed 100 PNdb at a 500 ft sideline. The candidates selected for evaluation, lift unit characteristics, weight comparison, and comparison of gas generator components are tabulated. F.O.S.

N73-19019* General Electric Co., Cincinnati, Ohio.

REMOTE LIFT FAN STUDY PROGRAM, VOLUME 2

Aug. 1972 104 p refs

(Contract NAS3-14408)

(NASA-CR-120970-Vol-2; R72AEG242-Vol-2) Avail: NTIS HC \$7.25 CSCL 01C

The engine cycle and configuration study with emphasis on the design requirements is reported. The preliminary concept survey, evaluation of selected candidates, and acoustic analysis are presented. It is concluded that single-stage tip turbines offer the best system potential with lift unit fan pressure ratios in the range 1.20 to 1.25. A compressor pressure ratio of 14/1 for the turbojet generator is recommended as the most advantageous design. F.O.S.

N73-19020* General Electric Co., Cincinnati, Ohio.

REMOTE LIFT FAN STUDY PROGRAM, VOLUME 3

Aug. 1972 467 p refs

(Contract NAS3-14406)

(NASA-CR-120972; R72AEG242-Vol-3) Avail: NTIS HC

\$25.50 CSCL 01C

The preliminary aerodynamic and mechanical design of the selected gas generator and lift unit components are reported. The design features for the 1.25 and 1.2 pressure ratio lift units selected for the preliminary design are discussed along with the turbojet and turbofan gas generators. The preliminary design layout, design analysis, and gas ducting design are described.

F.O.S.

N73-19021** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

STATUS OF CURRENT DEVELOPMENT ACTIVITY RELATED TO STOL PROPULSION NOISE REDUCTION

R. J. Rulis 1973 28 p refs Presented at Natl. Air Transportation Meeting; Miami, Fla., 24-26 Apr. 1973; sponsored by SAE (NASA-TM-X-68195; E-7350) Avail: NTIS HC \$3.50 CSCL 01C

The noise goal of 95 PNdb for STOL aircraft imposes severe technology demands on propulsion systems. Effects of this goal on the design of the propulsion system are reviewed. Results from recent development programs associated with STOL noise reduction, such as high bypass fan tests, 25 PNdb acoustic suppression tests, sonic inlets, and powered lift system noise tests, are presented. Integrated propulsion system designs for the blown flap and augmentor wing powered lift systems capable of meeting the noise goal are shown and the performance, installation, and economic penalties assessed.

Author

N73-19022# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).

VSTOL AIRCRAFT STABILITY AND CONTROL EXPERIENCED FROM METHODS AND RESULTS OF DO 31 FLIGHT TESTS [STABILITAET UND STEUERBARKEIT VON VSTOL-FLUGZEUGEN NACH VERFAHREN UND ERGEBNISSEN AUS DER DO 31-FLUGERPROBUNG]

Horst Wuennenberg Bonn Bundeswehramt 1972 99 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. der Verteidigung (BMVg-FBWT-72-25) Avail: NTIS HC \$7.00; Bundeswehramt, Bonn: 25 DM

The problems of stability and control of V/STOL aircraft are discussed. Though the V/STOL handling qualities criteria in AGARD-Rep. 577 and US-MIL-F-83300 correspond to a certain extent to the flight test results of the Do 31, the MIL-Spec. in particular is not applicable to jet lift V/STOL aircraft with attitude stabilization systems. As far as AGARD-Rep. 577 is concerned, additional information seems to be necessary in order to include the special problems of this category of V/STOL aircraft. The principles of control and stabilization used for the Do 31 have proved its validity and have even enabled the pilots to perform simulated IFR-transitions up to hovering flight. However, for an operational aircraft, improvements to simplify handling and further automation of the landing approach are essentially necessary for all-weather operations.

Author (ESRO)

N73-19023# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).

RESULTS OF VSTOL JET TRANSPORT AIRCRAFT DO 31 GROUND EROSION TESTS AND THEIR SIGNIFICANCE FOR VSTOL TECHNIQUES [ERGEBNISSE ZUR BODENEROSION BEIM VSTOL-STRAHLTRANSPORTFLUGZEUG DO 31 UND IHRE BEDEUTUNG FUER DIE VSTOL-TECHNIK]

Joerg Muench Bonn Bundeswehramt 1972 130 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. der Verteidigung (BMVg-FBWT-72-26) Avail: NTIS HC \$8.50; Bundeswehramt, Bonn: 25 DM

The theoretical and experimental investigations on ground erosion, carried out in connection with the development of the V/STOL transport aircraft Do 31, are summarized. A mobile test rig with a one stream Orinda 14 jet engine was developed for the experiments. The resistance, which is dependent on jet intensity, was tested of wet and dry grassland at Memmingen and Oberpfaffenhofen, conventional concrete, special concrete, asphalt, synthetic coating, and ground reinforced by water-glass.

The movement of particles in the wall jet was also investigated. Reduction of the lift jet intensity and special methods of STOL to avoid ground erosion are considered.

Author (ESRO)

N73-19024# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).

HOT GAS RECIRCULATION IN THE VSTOL JET TRANSPORT AIRCRAFT DO 31 AND ITS SIGNIFICANCE FOR FUTURE VSTOL DEVELOPMENTS [HEISSGASREZIRKULATION BEIM VSTOL-STRAHLTRANSPORTFLUGZEUG DO 31 UND IHRE BEDEUTUNG FUER ZUKUNFTIGE VSTOL-ENTWICKLUNGEN]

Peter Dick and Peter Kuehl Bonn Bundeswehramt 1972 97 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. der Verteidigung (BMVg-FBWT-72-29) Avail: NTIS HC \$7.00; Bundeswehramt, Bonn: 25 DM

Investigations on the reingestion of hot engine exhaust gases carried out during development of the Do 31 with models and original equipment and extending over a period of five years (1964-1969) are described. The following partial objectives were met step by step: (1) determination of volume and character of the recirculation problem; (2) determination of similar characteristics in order to transfer the various model results to the full-size equipment; (3) establishment of take-off procedures; (4) optimization of safety requirements, and (5) simplification of take-off and landing procedures. With these results, the problem may be regarded as being solved for the Do 31. Further investigations to determine recirculation problems of future VSTOL jet aircraft with advanced engines revealed that certain configuration-related predictions can be made.

Author (ESRO)

N73-19025# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).

VSTOL TRANSITION FLIGHT TECHNIQUES AND PROBLEMS OF THE JET TRANSPORT AIRCRAFT DO 31 AND THEIR SIGNIFICANCE FOR VSTOL TECHNIQUES [TECHNIK UND PROBLEMATIK DES VSTOL-UEBERGANGSFLUGES BEIM STRAHLTRANSPORTFLUGZEUG DO 31 UND IHRE BEDEUTUNG FUER DIE VSTOL-TECHNIK]

Heribert Friedel Bonn Bundeswehramt 1972 303 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. der Verteidigung (BMVg-FBWT-72-30) Avail: NTIS HC \$17.24; Bundeswehramt, Bonn: 25 DM

The techniques of VSTOL transition flight are explained using the Do 31 as an example. The problems presented by formulation and control of the transition flight path and their influence on transition performance are discussed in detail. The results of the Do 31 flight tests mainly concern the operation of V/STOL-aircraft. They are: take off transition is relatively easy; landing transition is very difficult and therefore uneconomic. The V/STOL operation can be improved by installation of a double control stick and an autopilot, maximum available deceleration can then be used, which is a positive safety factor in the case of an engine failure.

Author (ESRO)

N73-19026# Army Cold Regions Research and Engineering Lab., Hanover, N.H.

PRELIMINARY ECOLOGICAL EVALUATION OF THE EFFECTS OF AIR CUSHION VEHICLE TESTS ON THE ARCTIC TUNDRA OF NORTHERN ALASKA

Warren Rickard Sep. 1972 29 p refs (ARPA Order 1615)

(AD-751741; CRREL-SR-182) Avail: NTIS CSCL 13/6

Of prime concern in the Arctic is the need for an efficient means of transportation over both frozen and unfrozen arctic terrain. As part of the effort to develop such a means, the Advanced Research Projects Agency established a program to determine the potential for using an air cushion vehicle (ACV). Studies on the effects of ACV tests were conducted in two areas at Barrow, Alaska. One area was a drained lake bottom with a fairly homogeneous vegetation cover and soil type. The second area, much drier than the first, consisted of low-centered polygons composed of a wet tundra soil and a varying vegetation

complex. The initial effects of the ACV tests in both areas were quite similar. Author

N73-19027# Army Alaska, APO Seattle, Wash. 98749.
REPORT OF AN EXPERIMENT EXAMINING THE AIR CUSHION CONCEPT IN A LOGISTICAL ROLE IN THE ARCTIC. Final Report

W. J. Thompson Dec. 1972 87 p
 (AD-753527) Avail: NTIS CSCL 01/3

The Surface Effects Vehicle (SEV) concept experiment was conducted at Fort Greely, Alaska during the period February to September 1972. The objective of the experiment was to determine if the air cushion vehicle could be employed in a military logistical role in an Arctic environment. Air cushion vehicles have the mobility required to perform in a military logistical role in an Arctic environment in both summer and winter. The SEV can be operated and maintained in the severe Arctic environment by military personnel with aircraft maintenance skills. Author (GRA)

N73-19028# Bolt, Beranek, and Newman, Inc., Canoga Park, Calif.

NOISE FROM AIRCRAFT OPERATIONS, US NAVAL AIR STATION, LEMOORE, CALIFORNIA

Aug. 1972 36 p refs
 (Contract N62474-72-C-0344)

(AD-754111; BBN-2225) Avail: NTIS CSCL 20/1

The report provides descriptions of the aircraft noise environment for land areas on or in the vicinity of the Naval Air Station, Lemoore, California. The noise resulting from aircraft operations at NAS Lemoore is considered in some detail from the point of view of land use, and also with respect to potential hearing damage in maintenance areas on the station. Author (GRA)

N73-19029# Aeronautical Systems Div., Wright-Patterson AFB, Ohio.

CRITERIA FOR PREDICTING SPIN SUSCEPTIBILITY OF FIGHTER-TYPE AIRCRAFT

Robert Weissman Jun. 1972 102 p refs

(AD-753905; ASD-TR-72-48) Avail: NTIS CSCL 01C

An investigation was conducted to determine if there is a correlation between lateral-directional static stability characteristics and spin susceptibility. The effects of longitudinal static stability and adverse or proverse yaw were also considered. The motion of an airplane entering the high angle of attack, low speed flight regime is analyzed in six degrees of freedom. The C_n beta, dynamic, and aileron-alone divergence parameters are calculated for four aerodynamic cases. Results show that these parameters have promise as criteria for predicting spin susceptibility of fighter-type aircraft in the early stages of design and development. An airplane whose C_n beta, dynamic, and aileron-alone divergence parameters are both negative at near-stall angles of attack tends to be susceptible to spinning and an airplane with positive values for these parameters tends not to be susceptible to spinning. Author (GRA)

N73-19030+ Advisory Group for Aerospace Research and Development, Paris (France).

ENERGETICS FOR AIRCRAFT AUXILIARY POWER SYSTEMS

A. E. Fuhs, ed. (Naval Postgraduate School) Dec. 1972 314 p refs Mostly in ENGLISH; partly in FRENCH Proc. of 39th Meeting of the AGARD Propulsion and Energetics Panel held at Colorado Springs, 12-15 Jun. 1972
 (AGARD-CP-104) Avail: NTIS HC \$17.75

The proceedings of a conference on the use of superconductivity technology for electrical power generation in aircraft and missiles are presented. The advantages of superconductivity for power generation are described. The subjects discussed include: (1) behavior of composite superconducting materials, (2) superconducting generators in aircraft, (3) cryogenic and inductive energy storage, (4) advanced airborne auxiliary power systems, (5) extraction of auxiliary power from air breathing propulsion systems, (6) electrical generation and distribution

systems for supersonic aircraft, and (7) non radiating superconducting coils for energy storage. Line drawings, diagrams, charts, tables, and graphs are included to clarify the theoretical aspects.

N73-19036 Cranfield Inst. of Technology (England).

PROSPECTS FOR SUPERCONDUCTING GENERATORS IN AIRCRAFT

J. T. Hayden /in AGARD Energetics for Aircraft Auxiliary Power Systems Feb. 1972 7 p refs

A review is given of the characteristics of present conventional alternators and aircraft electrical power systems. Preliminary considerations in the use of superconducting windings in 400 Hz alternators indicate that it is difficult to argue a case in favour of using superconducting machines for typical systems in use at present. Further, there is probably a minimum size of 400 Hz generator for which it is practical to introduce superconducting windings below which there is no significant reduction in weight. If systems requiring powers of a few megawatts are considered, then the case for superconducting machines is much more promising providing that some cryogen (such as liquid nitrogen or liquid hydrogen) is already in the aircraft and available for cooling intermediate heat shields. Continued development in lightweight airborne helium refrigerators is also needed. Author

N73-19038 Ferranti-Packard Electric, Ltd., Toronto (Ontario).

LIGHTWEIGHT SUPERCONDUCTION MAGNET FOR AIRBORNE MHD GENERATORS

David L. Atherton /in AGARD Energetics for Aircraft Auxiliary Power Systems Feb. 1972 9 p refs Sponsored by USAF Aeropropulsion Lab. and Canadian Defence Res. Board

A large lightweight saddle-coil superconducting dipole magnet for airborne MHD generators is described. The magnet has a room temperature bore of 27.7 cm, a winding bore of 33 cm, a design field of 4.5 tesla, a magnetic length of 105 cm and a mass of 450 kilograms. The dipole field is generated by pancake winding whose cross sectional outline approximates overlapping circles. Lightweight necessitates high current density, 2,100a in a 2 mm. square conductor containing 200 twisted Nb-Ti filaments in a copper matrix. The Lorenz repulsive force between opposite sides of the magnet is 3850 kilogauss per centimeter of coil length. There are also large compressive forces on the former and repulsive forces between the ends. The mechanical structure therefore uses a highly stressed lightweight structure of filament wound epoxy glass composite. The dewar uses superinsulation and vapour cooled radiation shields. Vibration and shock analysis and pressure vessel design criteria determine the minimum mass dewar design. Author

N73-19039 Magnetic Corp. of America, Cambridge, Mass.

SUPERCONDUCTING GENERATORS

Z. J. J. Stekly (Tex. Univ. Austin) and H. H. Woodson /in AGARD Energetics for Aircraft Auxiliary Power Systems Feb. 1972 14 p refs Sponsored by United Aircraft Corp. and AFAPL

The development of alternating current machines using superconducting windings is discussed. The design philosophy and details of specific experimental generators are examined. The characteristics of the field winding based on electromagnetic, electromechanical, structural, and cryogenic effects are described. The design criteria resulting from the interaction of these parameters are developed. The results of a study of size and weight as a function of power level and frequency are presented. Author

N73-19040 Westinghouse Electric Corp., Pittsburgh, Pa. Research Labs.

SUPERCONDUCTING ELECTRICAL MACHINERY

C. J. Mole, J. H. Parker, Jr., and L. R. Lowry /in AGARD Energetics for Aircraft Auxiliary Power Systems Feb. 1972 15 p refs

(Contract F33615-71-C-1591)

The more important types of superconducting machines, the

features and problems inherent in such machines, and the more promising applications are reviewed. Both ac and dc superconducting machines are discussed with particular emphasis on the application of ac machines for aircraft use. Recent and current developments in the field are reported. Author

N73-19045 AiResearch Mfg. Co., Phoenix, Ariz.
ADVANCED AIRBORNE AUXILIARY POWER SYSTEM
D. F. Swenski, L. W. Norman, and A. D. Meshew /in AGARD
Energetics for Aircraft Auxiliary Power Systems Feb. 1972
12 p ref

An advanced auxiliary power unit (APU) was combined with an accessory drive system to form an auxiliary power system (APS). This APS was used as an exploratory development test bed for the development of advanced technology components. The APS included a 300 equivalent shaft horsepower APU configured to furnish bleed air from a split flow impeller and shaft power at 130 F, sea level ambient conditions. The APS was designed to provide standby power separate from the accessories and engine drive train, checkout, engine starting, and emergency power through a high-speed torque converter. The design of the APS was intended to form a test bed representing the optimum configuration as determined from a systems analysis, with a high degree of flexibility such that the components thus developed may be applicable to many other future APS designs. Author

N73-19046 Kloeckner-Humboldt-Deutz A.G., Oberursel (West Germany).
AUXILIARY POWER UNITS FOR SECONDARY POWER SYSTEMS
Erwin Schnell /in AGARD Energetics for Aircraft Auxiliary Power Systems Feb. 1972 9 p

The design principles for the auxiliary power units of a secondary power system for use in aircraft are presented. The single shaft turbine is compared with the free power turbine for auxiliary power unit applications. The equipments operated by the auxiliary power unit is discussed and the components of the electrical system are analyzed. Author

N73-19047 Messerschmitt-Boelkow G.m.b.H., Munich (West Germany).
PULSE JET ENGINE AS A SOURCE OF ENERGY FOR AUXILIARY POWER UNITS: PULSE GAS TURBINE WITHOUT COMPRESSOR
W. K. Eick /in AGARD Energetics for Aircraft Auxiliary Power Systems Feb. 1972 12 p

A short survey of the elements of an intermittent pulse jet engine, open on both sides, which has been tested up to the supersonic speed is presented. The results show that such an airbreathing unit can also be used as a gas generator acting upon a turbine rotor for taking off mechanical power. The basic design of the engine consists of a thin-walled welded steel construction of conical and cylindrical shape, without any mechanically moved, rotating or oscillating parts. A spark plug for intermittent external ignition for starting and a fuel control device belong to the basic version of the engine. The turbine is driven by the hot gases which are intermittently expelled from the combustion chamber. The power unit can also be selectively used after diversion as a propulsion engine. The low costs of manufacturing and maintenance for such engines are pointed out. The influence of the most important parameters is explained. The auto-ignition, based on the principle of residual gas including shock wave rate, is an important functional feature of the pulse jet engine. Author

N73-19048 Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio. Auxiliary Power Units.
DUAL MODE AUXILIARY POWER UNIT FOR HIGH MACH AIRCRAFT
Buryl L. McFadden, Jr. and Richard E. Quigley, Jr. /in AGARD
Energetics for Aircraft Auxiliary Power Systems Feb. 1973
9 p refs

Advanced high performance aircraft are projected to employ ramjet, turboramjet, and rocketramjet engines. Since ramjet engines do not incorporate rotating members, they cannot provide shaft horsepower for aircraft accessories and flight control systems. Therefore, some form of auxiliary power source will be required to furnish the hydraulic, electric, pneumatic, and shaft power for the various aircraft systems during flight, thus the auxiliary power source must become the prime and only source of shaft power during high speed flight. Various power source configurations to accomplish this are reviewed with emphasis on the potential of a single dual mode power source sized to provide all flight vehicle power throughout the entire operating regime of the aircraft including ground standby. Since they are totally independent, such a configuration will permit design optimization of both the main propulsion engines and the power system. Author

N73-19049 British Aircraft Corp., Preston (England). Military Aircraft Div.
INTEGRATION OF AUXILIARY POWER SYSTEMS WITH THE MULTI-SPOOL ENGINE
Len. W. Milsom /in AGARD Energetics for Aircraft Auxiliary Power Systems Feb. 1973 8 p

As engine technology advances certain engine/airframe interface problems arise with aircraft auxiliary power systems. Using a modern strike aircraft as the principal example, this paper examines the difficulties in meeting the airframe mechanical power requirements of generating excessive wasted energy in air bleed systems and of dissipating the waste heat from engine and airframe accessories. Much closer collaboration between airframe and engine contractors at the early stage of an aircraft project, in order to develop a combined approach to the solution of these problems, is recommended. Author

N73-19050 Motoren-Und Turbinen-Union. Muenchen G.m.b.H. (West Germany).
EXTRACTION OF AUXILIARY POWER FROM AIRBREATHING PROPULSION SYSTEMS
Klaus Bauerfeind /in AGARD Energetics for Aircraft Auxiliary Power Systems Feb. 1973 13 p

The characteristics of gas turbine engines for use as auxiliary power sources are discussed. The direct supply of mechanical power and pressurized air from turbines is examined. The most important criteria for the auxiliary power sources are identified as: (1) maximum possible power delivery points, (2) compressor surge margins, (3) effect on handling characteristics of aircraft, and (4) effect on windmilling characteristics of turbine engine. Data are presented in the form of graphs to show interrelationships of turbine engine parameters. Author

N73-19051 Politecnico di Milano (Italy). Ist. di Macchine.
A METHOD FOR PRELIMINARY ANALYSIS OF MHD GENERATOR PERFORMANCE
C. Casci, A. Coghe, and U. Ghezzi /in AGARD Energetics for Aircraft Auxiliary Power Systems Feb. 1972 12 p refs

The characteristics of magnetohydrodynamic generators for aircraft and spacecraft applications are discussed. A method for analyzing the parameters of a magnetohydrodynamic generator is developed. The analysis is obtained by fixing the total enthalpic difference between the inlet and outlet sections of the duct and by examining the various possibilities through which such a condition may be achieved. Thermodynamic and electromagnetic quantities are studied in relation to the velocity difference between the inlet and outlet sections of the duct and by some other parameters, such as expansion ratio and form factor of the duct. Author

N73-19052 Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio.
DEVELOPMENTS IN AIRCRAFT ELECTRICAL POWER SYSTEMS
Robert H. Johnson /in AGARD Energetics for Aircraft Auxiliary

Power Systems Feb. 1972 7 p refs

A summary of Air Force research and development programs in aircraft electrical power systems and components is presented. The planning process used to validate research programs is discussed with emphasis on the resultant motivation to develop specific classes of technology. Specific programs discussed are: (1) solid state power controllers, (2) gate controlled switch technology, (3) solid state electric power simulator tests, and (4) high temperature electrical generators, wire, and connectors. Author

N73-19053 Vought Aeronautics, Dallas, Tex.
APPLICATION OF SOLID STATE SWITCHING AND MULTIPLEXING TO AIRCRAFT ELECTRICAL SYSTEMS
 Clyde W. Jones (AFAPL) and Jim Courter In AGARD Energetics for Aircraft Auxiliary Power Systems Feb. 1973 9 p

The application of solid state switching, multiplexing, and electrically programmable logic to aircraft electrical systems is discussed. The effects of the use of solid state switching technology on electrical system weight, reliability, electromagnetic interference, and quality of power delivered to loads are analyzed. A summary of problems encountered with proposed solutions, during a program in which a completely solid state electrical system for an A-7 aircraft was evaluated, is included. Areas of improvement and expanded capability are also enumerated. Author

N73-19054 Royal Aircraft Establishment, Farnborough (England). Engineering Physics Dept.
ELECTRICAL GENERATION AND DISTRIBUTION SYSTEMS FOR FUTURE SUPERSONIC AIRCRAFT
 A. Bainbridge In AGARD Energetics for Aircraft Auxiliary Power Systems Feb. 1972 7 p refs

The size of the total electrical load and the temperature range over which some components will have to operate make it necessary to study new generation and distribution techniques to satisfy the demands of future aircraft flying in the supersonic or hypersonic range. This paper is restricted to supersonic aircraft and discusses recent proposals for improved distribution systems incorporating solid state switching and using remote control of protective devices through a multiplexed system. The scope for high temperature wiring is briefly discussed and a few recent developments in generators and power cables are described, since the generating system is particularly vulnerable to extreme environmental conditions. Author

N73-19056 British Aircraft Corp., Weybridge (England).
PNEUMATICS IN SUPERSONIC ENERGETICS
 John Wotton In AGARD Energetics for Aircraft Auxiliary Power Systems Feb. 1973 15 p

A pneumatics orientated integrated system concept developed for subsonic civil aircraft is examined in its relation to supersonic operation. The principle of waste heat extraction for the generation of auxiliary power supplies is found to be even more viable due to greater cabin pressure differential during cruise, and the level of engine compressor tapping required in consequence. The economics of engine bleed are examined in the light of virtually free electrical generation in the method employed. Pneumatic power conversion is shown to be at least competitive with hydraulic and other equivalents, and the requirements of power flying controls to be satisfactorily met. Author

N73-19254# Air Force Academy, Colo.
ROCK-CABLE, A COMPUTER PROGRAM TO SIMULATE AIRCRAFT TO MISSILE CABLE DYNAMICS
 Terry D. Hinnerichs and Steven A. Crist Oct. 1972 43 p refs (AD-753907; USAFA-RR-72-4) Avail: NTIS

The report describes the development of a FORTRAN computer program that simulates the response, i.e., cable velocities and position vs. time of a cable being deployed from a missile as it flies out and away from the aircraft that the cable is attached to. The main objective of this program is to point out

what conditions might allow the cable to wrap around the aircraft as the missile is deploying cable. The program is quite general in that any flightpath for the aircraft or missile can be directly employed into their respective subroutines and the state of the entire cable is then calculated as a function of time. The longitudinal shapes of the cable between the aircraft and missile have been plotted for two missile flightpaths and for various tensions imposed on the cable by the missile as it deploys the cable. Author (GRA)

N73-19255# Air Force Academy, Colo.
DYNAMICS OF CABLES TOWED FROM AIRCRAFT
 James G. R. Hansen and Steven A. Crist Oct. 1972 94 p refs (AD-753909; USAFA-RR-72-8) Avail: NTIS CSCL 09/5

The report describes a lumped-mass computer simulation of a trailing wire system towed by an orbiting aircraft. The USAF U-10 aircraft flight conditions were used as applied to three flightpaths: constant altitude circular, constant altitude elliptical, and non-constant altitude circular orbit. These flightpaths were flown in no wind and 30 knot wind conditions. Wire lengths of 4000 ft and 8000 ft were used where the free end was attached to a circular sphere of 25 and 100 lbs. The results from 12 orbiting trailing wire configurations are tabulated and/or plotted. One of the main objectives in this analysis was to determine how yo-yo of the free end of the wire in wind might be alleviated or at least minimized. Author (GRA)

N73-19256# Air Force Academy, Colo.
STEADY STATE SHAPE OF ORBITING TRAILING WIRE SYSTEM

Terry D. Hinnerichs and Steven A. Crist Oct. 1972 37 p refs (AD-753908; USAFA-RR-72-7) Avail: NTIS CSCL 09/5

The computer program described in this report simulates the spiral curve of a wire being towed behind an orbiting aircraft after steady state conditions have developed. Taking the case of a wire and drogue device towed by an aircraft in a constant orbit at a constant altitude, the authors divided the wire into n segments. Then each segment was treated as being in static equilibrium. Starting at the drogue end where all forces are known, general equations were derived which could be applied to each cable segment proceeding up to the aircraft. These equations were then programmed in FORTRAN 4 language. The results of this program's simulation of a USAF T-29 towing a wire are shown. Author (GRA)

N73-19259 Virginia Polytechnic Inst. and State Univ., Blacksburg.
FOLLOWING THEORY WITH APPLICATIONS Ph.D. Thesis
 Wilbert Edward Wilhelm 1972 203 p
 Avail: Univ. Microfilms Order No. 72-24462

The concept of following was established and shown to explain a number of phenomena. A theory was provided which describes such processes as feedback controls, Markov processes, and the flow of automobiles and aircraft. Two types of stochastic following situations were considered. One demonstrated a mode of following in which entities influence each other through mutually repelling forces. The other exemplified the affect of acceleration noise in a mode of following associated with rectilinear motion. Mathematical analogies among queueing processes, car following models, and feedback controls were established. A derivation of the transient and steady state solutions to an alternating renewal process resulted from these analogies. Dissert. Abstr.

N73-19266# Federal Aviation Administration, Washington, D.C.
Office of Systems Engineering Management.
ENGINEERING AND DEVELOPMENT PROGRAM PLAN: AIRPORT PAVEMENT
 Oct. 1972 42 p (FAA-ED-08-2) Avail: NTIS HC \$4.25

A research program for upgrading airport pavement technology by a coordinated contractor/in-house/industry effort is presented. Data cover: (1) design guidance and criteria using current methodology to meet current and future pavement load requirements with available materials, at reasonable cost with adequate life span, (2) pavement material and construction

standards to insure that design criteria are realized, (3) test methods and standards for evaluating performance of new pavement and predicting the life span of existing pavements, (4) methods for improving, repairing, and rehabilitating existing pavement and surfaces to improve effectiveness and extend service life, and (5) rational pavement structural design criteria procedures based upon a mathematical model capable of simulating pavement load response. Author

N73-19269* Washington Univ., Seattle.

WIND TUNNEL INTERFERENCE FACTORS FOR HIGH-LIFT WINGS IN CLOSED WIND TUNNELS Ph.D. Thesis - Princeton Univ.

Robert G. Joppa Washington NASA Feb. 1973 126 p refs (Grant NGL-48-002-010) (NASA-CR-2191) Avail: NTIS HC \$3.00 CSCL 14B

A problem associated with the wind tunnel testing of very slow flying aircraft is the correction of observed pitching moments to free air conditions. The most significant effects of such corrections are to be found at moderate downwash angles typical of the landing approach. The wind tunnel walls induce interference velocities at the tail different from those induced at the wing, and these induced velocities also alter the trajectory of the trailing vortex system. The relocated vortex system induces different velocities at the tail from those experienced in free air. The effect of the relocated vortex and the walls is to cause important changes in the measured pitching moments in the wind tunnel. Author

N73-19288 Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany).

TURBULENT PRESSURE MEASUREMENTS ON ENGINE INLET FLOWS [MESSUNG VON DRUCKTURBULENZEN IN TRIEBWERKSEINLAUFEN]

W. Habig In DGLR Report on the 3d Meeting of the DGLR-Sci. Comm. on Flow Mech. Test Tech. Oct. 1972 p 87-91 refs In GERMAN

Total pressure measurements for the cross section of a supersonic diffuser inlet flow model show that: (1) time fluctuations in total pressure are usually distributed over a frequency region less than or equal to 1000 Hz with local variations in effective turbulence values; (2) time fluctuations for measured static flow pressure are about 10 times lower than total pressure when acoustic waves are absent. Static pressure fluctuations can reach up to 50% of total pressure under certain conditions; (3) time variations in flow density are proportional to measured static pressure fluctuations; and (4) acoustic wave and axial flow velocity variations in the turbulent field can be determined by correlating total pressure propagation time, static pressure, and flow density. Transl. by G.G.

N73-19291 Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany).

CONSTRUCTION METHODS FOR AEROELASTIC MODELS IN RATIONAL FLUTTER STUDIES [BAUWEISEN AEROELASTISCHER MODELLE FUER EINE RATIONELLE FLAT-TERUNTERSUCHUNG]

Heinz Hoenlinger In DGLR Report on the 3d Meeting of the DGLR-Sci. Comm. on Flow Mech. Test Tech. Oct. 1972 p 159-185 refs In GERMAN

A combinatorial numerical-experimental flutter analysis method is reported for the development of airplanes with variable geometries. Designs of various aeroelastic flutter model geometries for wind tunnel simulations consider velocity limitations, oscillatory loads, and flexibility and stiffness matrices of beam network structures. Transl. by G.G.

N73-19311* Northrop Corp., Hawthorne, Calif. Aircraft Div. **THE CALCULATION OF THREE DIMENSIONAL SUPERSONIC FLOWS AROUND SPHERICALLY-CAPPED SMOOTH BODIES AND WINGS. VOLUME 1: THEORY AND APPLICATION** Final Report, 1 Dec. 1971 - 3 Jul. 1972

Chong-Wei Chu and Sidney A. Powers Sep. 1972 88 p refs (Contract F33616-72-C-1429; AF Proj. 1366) (AD-753895; NOR-72-87-Vol-1; AFFDL-TR-72-91-Vol-1) Avail:

NTIS CSCL 20/4

The report describes the theories, the numerical methods and the computer programs developed for determining the inviscid three-dimensional flow about smooth shapes at supersonic speeds. Volume 1 describes the theoretical and numerical approaches and compares two sample cases with experiment: a blunted 15 deg cone at 20 deg angle of attack in helium at $M = 14.9$, and a 70 deg slab delta wing at 15 deg angle of attack in air at $M = 9.6$. The numerical results are in close agreement with the experimental data. Author (GRA)

N73-19318* Massachusetts Univ., Amherst. School of Engineering.

CALCULATION OF INLET FLOWS BY MEANS OF A CLOSED VORTICITY DISTRIBUTION APPLIED TO DUCTED PROPELLERS

Ronald J. Weetman and Duane E. Cromack Dec. 1972 106 p refs

(Contract N00014-68-A-0146; NR Proj. 200-016)

(AD-754114; UM-72-11) Avail: NTIS CSCL 20/4

The investigation concerns inlet flow calculations applied to ducted propellers. The analysis is classified as that of an inlet flow since the ducted propeller wake is assumed to be at a constant diameter. A closed distribution of ring vortices is used to describe the duct and wake. By forming a closed distribution, the velocity can be equated directly to the vorticity. With this representation, singular integral equation of the first kind is formulated for the vorticity in terms of the streamline enclosing the duct and wake. Several techniques incorporated in the numerical solution of this integral equation are presented. This analysis provides a needed solution for ducted propellers operating at low speeds and statically, as well as at high speeds. Author (GRA)

N73-19423 Princeton Univ., N.J.

AIR SPEED MEASUREMENT WITH THE ION BEAM OF THE POSITIVE CORONA DISCHARGE Ph.D. Thesis

Willard Francis Burke 1972 269 p

Avail: Univ. Microfilms Order No. 72-24669

A beam of ions is a sensitive probe with which low air speeds may be accurately measured. The influence of transverse air flow on a beam of ions produced in the positive corona discharge is discussed. Beam deflection is proportional to air speed and depends on gas density and impurity concentrations in air. Sensors are linear in range between 3 m/s and 60 m/s. Error is determined from the quality of the accompanying electronic circuits and meters to be approximately 2%. The problem is how to keep the ratio of deflection to speed constant in a changing environment. An air speed measurement technique is derived which is independent of environmental influences. Air speed is measured independent of gas mass density and humidity. The measurement technique is derived for geometries like those with fine wire or thin needle sources which have relatively low corona thresholds and high current densities. Dissert. Abstr.

N73-19621* Martin Marietta Corp., Denver, Colo.

AUTOMATED DESIGN AND OPTIMIZATION OF FLEXIBLE BOOSTER AUTOPILOTS VIA LINEAR PROGRAMMING. VOLUME 1 Final Report

Francis D. Hauser Dec. 1972 136 p refs

(Contract NAS8-28482)

(NASA-CR-124124; MCR-72-282-Vol-1) Avail: NTIS HC \$9.00 CSCL 17G

A nonlinear programming technique was developed for the automated design and optimization of autopilots for large flexible launch vehicles. This technique, which resulted in the COEBRA program, uses the iterative application of linear programming. The method deals directly with the three main requirements of booster autopilot design: to provide (1) good response to guidance commands; (2) response to external disturbances (e.g. wind) to minimize structural bending moment loads and trajectory dispersions; and (3) stability with specified tolerances on the vehicle and flight control system parameters. The method is applicable to very high order systems (30th and greater per flight condition). Examples are provided that demonstrate the successful application of the employed algorithm to the design of autopilots for both single and multiple flight conditions. Author

N73-19622*# Martin Marietta Corp., Denver, Colo.
**AUTOMATED DESIGN AND OPTIMIZATION OF FLEXIBLE
 BOOSTER AUTOPILOTS VIA LINEAR PROGRAMMING.
 VOLUME 2: USER'S MANUAL**

Francis D. Hauser, Glen D. Szollosi, and W. Stevens Lakin Dec. 1972 171 p refs
 (Contract NAS8-28482)
 (NASA-CR-124125; MCR-72-282-Vol-2) Avail: NTIS HC \$10.75 CSCL 17G

COEBRA, the Computerized Optimization of Elastic Booster Autopilots, is an autopilot design program. The bulk of the design criteria is presented in the form of minimum allowed gain/phase stability margins. COEBRA has two optimization phases: (1) a phase to maximize stability margins; and (2) a phase to optimize structural bending moment load relief capability in the presence of minimum requirements on gain/phase stability margins.

Author

N73-19623# Deutsche Gesellschaft fuer Luft- und Raumfahrt, Cologne (West Germany).

REPORT ON THE DGLR-SYMPOSIUM ON AIR TRAFFIC OPERATION

H. G. Nuesser Dec. 1972 66 p In GERMAN; ENGLISH summary Symp. held at Cologne, 15 Sep. 1972 (DLR-Mitt-72-24) Avail: NTIS HC \$5.50; ZLDI Munich: 14.30 DM

The proceedings of a symposium on flight operations and air traffic control are presented. The present situation and problems affecting airports, general aviation, air traffic controllers, and governmental agencies for air navigation are discussed. Actions being taken by various segments of the air transportation organization are included.

N73-19624 Arbeitsgemeinschaft Deutscher Verkehrsflughafen, Stuttgart (West Germany).

THE TRAFFIC LANDING FIELDS TODAY [DIE VERKEHRSLANDEPLATZ HEUTE]

Kurt Siebenwurst In DGLR Report on the DGLR-Symp. on Air Traffic Operation Dec. 1972 p 7-14 In GERMAN

The characteristics and functions of various types of aircraft landing fields are discussed. The organization for the construction, control, and operation of airfields is described. A statistical analysis of the growth of air traffic in Germany is developed to show the basic cause for many of the air traffic problems. Plans for the development of airports and the expected benefits to flight safety are included.

Transl. by P.N.F.

N73-19625 Arbeitsgemeinschaft Deutscher Verkehrsflughafen, Stuttgart (West Germany).

AIRPORTS TODAY: SIGNIFICANCE AND PROBLEMS OF AIRPORTS IN TODAY'S AIR TRAFFIC [FLUGHAFEN HEUTE BEDEUTUNG UND PROBLEME DER FLUGHAFEN IM HEUTIGEN LUFTVERKEHR]

Udo Wolfram In DGLR Report on the DGLR-Symp. on Air Traffic Operation Dec. 1972 p 15-24 In GERMAN

A summary of airports constructed in various European countries and England which comprise a commercial air traffic net is presented. The functions performed by commercial airports are described. The effects of airport operations on the environment are analyzed. The preliminary planning of airports to insure their ability to accommodate the transportation demands is discussed. Methods for improving flight operations and the application of new technologies to airport development are examined.

Transl. by P.N.F.

N73-19626 Deutscher Aeroclub e.V., Frankfurt am Main (West Germany).

FLIGHT OPERATIONS FROM THE VIEWPOINT OF GENERAL AVIATION [FLUGBETRIEB AUS DER SICHT DER ALLGEMEINEN LUFTFAHRT]

Wolfgang Trinkaus In DGLR Report on the DGLR-Symp. on Air Traffic Operation Dec. 1972 p 25-31 In GERMAN

The problems of traffic control of general aviation aircraft in

Germany are discussed. A statistical analysis of general aviation flying in Germany to include the number of licensed pilots, the number and types of aircraft, and the extent of flying activity is presented. The present methods for controlling general aviation aircraft to avoid aircraft accidents are explained. The control of general aviation aircraft in the United States is reported to show possible applications to the control of German aircraft activities.

Transl. by P.N.F.

N73-19627 Deutsche Lufthansa Aktiengesellschaft, Frankfurt am Main (West Germany).

FLIGHT OPERATIONS FROM THE VIEWPOINT OF COMMERCIAL AIRLINES [FLUGBETRIEB AUS DER SICHT EINER LUFTVERKEHRSGESELLSCHAFT]

Rolf Bebbler In DGLR Report on the DGLR-Symp. on Air Traffic Operation Dec. 1972 p 33-48 In GERMAN

A statistical analysis of the growth of commercial airlines in Germany during the past 20 years is presented. The problems in air traffic control which have resulted from this expansion are described. The functions of an operations control center to provide safer flying conditions and more efficient operation are explained. The efforts of German airlines to meet the four basic requirements of: (1) safety, (2) passenger comfort, (3) schedule adherence, and (4) economy are reported. The anticipated extent and nature of civil aviation activities in Europe in the near future are included.

Transl. by P.N.F.

N73-19628 Verband Deutscher Flugleiter e.V., Frankfurt am Main (West Germany).

FLIGHT SAFETY PROBLEMS FROM THE VIEWPOINT OF THE AIR TRAFFIC CONTROLLER [FLUGSICHERUNGSPROBLEME AUS DER SICHT DER FLUGLOTSEN]

c02

Wolfgang Kassebohm In DGLR Report on the DGLR-Symp. on Air Traffic Operation Dec. 1972 p 49-54 In GERMAN

The requirements for air traffic control procedures in German airspace which arise from the operation of commercial, military, and general aviation aircraft are described. A statistical analysis of the overall increase in air traffic over Germany from foreign and domestic operations is presented. A reformed system for air traffic procedures is developed. The continued importance of the air traffic controller for the safe operations of the system is emphasized.

Transl. by P.N.F.

N73-19635 Joint Publications Research Service, Arlington, Va.
CONDITION OF DRIFT INVARIANCE OF TWO-STAGE GYROSCOPE WITH ARBITRARY GAS-LUBRICATED MAIN BEARINGS TO ACTIVE ACCELERATIONS

c14

S. G. Dadayev and G. A. Zavyalov In its Inertial Systems 7 Feb. 1973 p 13-17 refs

The conditions are determined under which the drift of a two-stage gyroscope with arbitrary gas-lubricated main rotor bearings in the presence of arbitrary accelerations is equal to zero.

Author

N73-19642# Sperry Rand Corp., St. Paul, Minn. Defense Systems Div.

KNOXVILLE ASSOCIATIVE PROCESSOR EVALUATION Final Report

B. G. Dietzler Nov. 1972 324 p

(Contract DOT-FA70WA-2289)

(PX-6406-Rev-A; FAA-RD-73-17) Avail: NTIS HC \$18.25

An evaluation of the associative processor (AP) in performance of the tracking and conflict detection functions in a real-time terminal ATC environment is reported. Design data for the 1230 conflict resolution program and for all AP programs are included. A summary of the results is included.

F.O.S.

N73-19643# Stanford Research Inst., Menlo Park, Calif.
COMPUTER-AIDED TRAFFIC/AIRWAY/VOR(TAC) NETWORK METHODOLOGIES. PART 1: TECHNIQUES OF AIR ROUTE NETWORK DESIGN (TASKS 1-3) Final Report,

Feb. 1971 - Aug. 1972

Waheed Siddique Aug. 1972 153 p refs

(Contract DOT-FA71WA-2547; SRI Proj. 1096)

(FAA-RD-72-118-1-Pt-1) Avail: NTIS HC \$9.75

The development of a computer-aided air route network design methodology is discussed. The subjects presented are: (1) establishment of route intersection points and angles, (2) establishment of various network attributes, (3) merging and bending routes, and (4) computer and plot programs. Mathematical models are presented to analyze the parameters which affect the computer program. Author

N73-19644# Stanford Research Inst., Menlo Park, Calif.
COMPUTER-AIDED TRAFFIC/AIRWAY/VOR(TAC) NETWORK METHODOLOGIES. PART 2: TECHNIQUES OF VORTAC GRID DESIGN (TASK 4) Final Report, Feb. 1971 - Aug. 1972

Waheed Siddiquee Aug. 1972 101 p refs

(Contract DOT-FA71WA-2547; SRI Proj. 1096)

(FAA-RD-72-118-2-Pt-2) Avail: NTIS HC \$7.25

The development of a systematic methodology and associated computer programs for the optimal design of a national grid of high altitude VOR/VORTAC facilities is described. Various techniques, models, and computer operations are presented. The subjects include the following: (1) project scope, ground rules, and problem formulation, (2) the family of VORTAC grid attribute models, (3) design methodologies and techniques, and (4) program to implement a preliminary pattern shifting methodology. Author

N73-19645# Ohio Univ., Athens. Avionics Engineering Center.
INSTRUMENT LANDING SYSTEM IMPROVEMENT PROGRAM GRADIENT CLEARANCE MONITOR Final Report, 1 Jul. 1971 - 1 Oct. 1972

Michael J. Stefanik Oct. 1972 90 p refs

(Contract DOT-FA69WA-2066)

(FAA-RD-72-147) Avail: NTIS HC \$6.50

Selected monitoring techniques to obviate the need for glide slope clearance flight checks have been identified. Of those investigated, the gradient clearance monitor concept appears to be the most promising technique for practical solution to the problem of ascertaining glide slope clearance signal. Feasibility is demonstrated through Fresnel zone commonality analysis and the design, fabrication, and experimental evaluation of the proposed monitor in operation with null-reference, glide-slope system. The results of this study are reported. Details include the development of three methods for the evaluation of gradient clearance monitor data involving both manual and computer solutions. Flight measurements to verify the monitoring of controlled, system faults have been used to investigate monitor credibility. A preliminary theoretical investigation indicates this monitoring concept is also compatible with sideband-reference and capture-effect systems. Results of this study support the concept of a far-field, environmental, glide-slope monitor. Author

N73-19646# Mitre Corp., McLean, Va.
CONTROLLER PRODUCTIVITY STUDY Final Report

R. A. Rucker, R. D. Parlow, P. R. Sterfels, and D. S. Mayer Feb. 1973 128 p refs

(Contract DOT-FA70WA-2488)

(MTR-6110; FAA-EM-73-3) Avail: NTIS HC \$8.50

An analysis of the effects of automation on the productivity of air traffic control and flight services staffs over the next 10 to 20 years. It is concluded that an aggregate five percent per year productivity gain is achievable. The improvement will depend on an aggressive development and implementation plan. Author

N73-19651# Ohio Univ., Athens. Dept. of Electrical Engineering.
DESIGN, CONSTRUCTION AND DEMONSTRATION OF AN AIRBORNE, LOW FREQUENCY, PHASE-STABLE RECEIVER

Frederick J. Kiko Oct. 1972 90 p refs

(Contract DAAB07-68-C-0084)

(AD-754027; EER-16-8; ECOM-0084-S-1) Avail: NTIS CSCI 17/7

Aircraft navigation using direct-ranging radio methods relies upon the processing of the carrier phase delay information accrued between a transmitter and a user. The first requirement following reception of the carrier wave is to raise its amplitude to a useable value. An RF filtering and amplification scheme using

analog methods is invariably used whether detection and further processing is achieved by analog or digital methods. The primary design requirement for a navigation receiver for direct-ranging applications is throughput phase stability. In the elected design a fixed-tuned TRF cascade of LC filters and integrated circuit gain blocks exhibits a stability of one electrical degree in the LF band at 300 kHz with a one sigma standard deviation. Measured performance includes a 3 db overall bandwidth of 1.9 kHz, a noise figure of 6 db and a maximum voltage gain of 70 db. Author (GRA)

N73-19666# National Aeronautical Establishment, Ottawa (Ontario).

A SIMPLE MODEL OF SHOCK CELL NOISE GENERATION AND ITS REDUCTION

Y. Y. Chan Oct. 1972 46 p refs

(NRC-12923; LR-564) Avail: NTIS HC \$4.50

Based on the data of near field surveys of the sound pressure from a choked jet, a simple model is proposed for the mechanism of the screech generation. A convected wave propagates downstream along the jet boundary and is modulated by its interactions with the shock-expansion waves of the jet. These interactions generate strong dipole radiations. Using this model, an excellent reproduction of the essential features of the experimental results is obtained. By preventing the formation of shock waves inside the jet, the strong dipole radiation and hence the screech noise can be eliminated. Design data for perforated nozzles to achieve full expansion of the jet are provided. This avoids the mechanical complication of an adjustable convergent-divergent nozzle. Author

N73-19697*# Virginia Univ., Charlottesville. Research Labs. for the Engineering Sciences.

DRAG COEFFICIENTS FOR SPHERES IN FREE MOLECULAR FLOW IN O AT SATELLITE VELOCITIES

John W. Boring and Robert R. Humphris Washington NASA Mar. 1973 39 p refs

(Contract NAS1-2538)

(NASA-CR-2233) Avail: NTIS HC \$3.00 CSCL 20H

The drag coefficients for the Echo 1 and Explorer 24 spherical surfaces in an O environment were experimentally determined over an energy range of 4 to 200 eV. The experiment was performed by generating a beam of atomic oxygen ions of the proper energy, neutralizing a portion of the beam, and then allowing only the neutral O particles to strike a very sensitive torsion balance. The momentum transferred to the surface was determined from the deflection of the torsion balance. At the lower energies, the more intense ion beam had to be used instead of the neutral beam. The drag coefficients are found to be slightly greater than 2 at energies corresponding to satellite velocities. Author

N73-19793* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

GAS TURBINE ENGINE FUEL CONTROL Patent

Harold Gold, inventor (to NASA) Issued 30 Jan. 1973 12 p Filed: 28 May 1971 Supersedes N72-10824 (10 - 01, p 0121)

(NASA-Case-LEW-11187-1; US-Patent-3,713,290;

US-Patent-Appl-SN-147922; US-Patent-Class-60-39,28R) Avail: US Patent Office CSCL 21E

A variable orifice system is described that is responsive to compressor inlet pressure and temperature, compressor discharge pressure and rotational speed of a gas-turbine engine. It is incorporated into a hydraulic circuit that includes a zero gradient pump driven at a speed proportional to the speed of the engine. The resulting system provides control of fuel rate for starting, steady running, acceleration and deceleration under varying altitudes and flight speeds.

Official Gazette of the U.S. Patent Office

N73-19794# Advisory Group for Aerospace Research and Development, Paris (France).

BOUNDARY LAYER EFFECTS IN TURBOMACHINES

J. Surugue, ed. (ONERA, Chatillon-sous-Bagneux, France) Dec. 1972 473 p refs In ENGLISH; partly in FRENCH

(AGARD-AG-164; AGARDograph-164) Avail: NTIS HC \$25.75

Studies dealing with the role of boundary layers in turbomachine design and operation are reported. The areas of investigation include subsonic, supersonic, and transonic flow machines.

N73-19798 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Aerodynamik.

INFLUENCE OF THE DEGREE OF TURBULENCE ON THE AERODYNAMIC COEFFICIENTS OF CASCADES c12

R. Kiock *In* AGARD Boundary Layer Effects in Turbomachines Dec. 1972 p 73-88 refs

An inviscid degree of turbulence is calculated from the circumferential distribution of the potential flow velocity behind a rotating cascade. This is compared with measurements of the degree of turbulence at a stator inlet of a multi-stage axial compressor. Extensive measurements on the influence of the turbulence level on the aerodynamic coefficients of several two-dimensional compressor cascades were carried out. These contained wake traverses, boundary layer measurements and pressure distribution on the profiles. These investigations were carried out in incompressible flow in the range of Reynolds numbers between 90,000 and 270,000 both in a low speed and a high speed cascade wind tunnel. Author

N73-19803 Office National d'Etudes et de Recherches Aeronautiques, Paris (France).

INFLUENCE OF ANGLE OF ATTACK AND DEFLECTION ON BOUNDARY LAYER FLOW IN UPRIGHT CASCADE BLADES [INFLUENCE DE L'ANGLE D'ATTAQUE ET DE LA DEFLEXION SUR LE DECOLLEMENT DE LA COUCHE LIMITE DANS UNE GRILLE D'AUBES DE REDRESSEUR] c12

Jacques Paulon *In* AGARD Boundary Layer Effects in Turbomachines Dec. 1972 p 187-201 refs *In* FRENCH

Cascade blade performance, as affected by boundary layer flow incidence and strong deflection, is examined. Trailing edge flow, backflow, and static pressure degradation are analyzed in detail. Transl. by E.H.W.

N73-19804 Technische Universitaet, Brunswick (West Germany). Inst. fuer Stroemungsmechanik.

THE EFFECT OF AXIAL VELOCITY RATIO ON THE AERODYNAMIC COEFFICIENTS OF A COMPRESSOR CASCADE IN VISCOUS FLOW c12

U. Stark *In* AGARD Boundary Layer Effects in Turbomachines Dec. 1972 p 205-220 refs

Both theoretical and experimental investigations of the effect of axial velocity ratio on the aerodynamic coefficients of two compressor cascades with NACA 65-(10)06 profiles are described. For the potential flow calculations the Pollard-Horlock method was selected. Boundary-layer calculations were performed based on the potential flow velocity distributions. The aerodynamic coefficients were calculated from the boundary-layer parameters at the blade trailing edge. The experimental investigations were carried out in a low-speed cascade tunnel. Both the theoretical and experimental results show a considerable effect of the axial velocity ratio on the aerodynamic performance of compressor cascades. The agreement between theory and experiment is quite satisfactory in as far as no severe flow separation occurs. Author

N73-19805 Motoren- und Turbinen-Union Muenchen G.m.b.H. (West Germany).

THE INFLUENCE OF AXIAL VELOCITY DENSITY RATIO ON COMPRESSOR CASCADE PERFORMANCE IN COMPRESSIBLE FLOW c12

W. Heilmann *In* AGARD Boundary Layer Effects in Turbomachines Dec. 1972 p 221-240 refs

Results of theoretical and experimental investigations on the influence of the ratio between the axial velocity density upstream and that downstream on the performance of plane compressor

cascades in compressible flow are presented. Tests were performed in a 7-inch transonic wind tunnel where upstream turbulence levels were varied. It could be demonstrated that the change in cascade performance with the axial velocity density ratio substantially depends upon the blade boundary layer behaviour. At fully turbulent boundary layers the axial velocity density ratio influences only the separation point positions. At laminar-turbulent boundary layers in addition the transition point position from which the separation point positions depend will be influenced. Boundary layer calculations conducted in the theoretical part of the investigation have qualitatively confirmed the experimentally achieved results as far as the influence of the axial velocity density ratio on the transition and separation point position is concerned. Total pressure loss at various axial velocity density ratios was calculated by applying an approximative method of determining the characteristic boundary layer values in separated flow and then comparing with the test results. Author

N73-19809 Institute TNO for Mechanical Constructions, Delft (Netherlands).

MEASURED AND CALCULATED TURBULENT BOUNDARY LAYER FLOW IN A VANELESS RADIAL DIFFUSER c12

C. B. V. D. Voorde and J. Bos *In* AGARD Boundary Layer Effects in Turbomachines Dec. 1972 p 293-310 refs

A method is presented for predicting two-dimensional flow through a radial diffuser with flat parallel walls. The method is based on the integral entrainment method and is valid until the flow is fully developed. Equations are given for: prediction of the velocity distribution across the diffuser width at any arbitrary station, prediction of the radial distribution of the static pressure recovery, and calculation of the diffuser efficiency from the predicted and measured flow. An experiment conducted for validation of the prediction method is described. During the experiment very accurate measurements were made of the velocity distribution across the constant diffuser width at various stations along a diffuser radius. The experimental values concurred well with predicted values. D.L.G.

N73-19811 Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).

SECONDARY FLOW RESEARCH AT THE VON KARMAN INSTITUTE c12

J. W. Salvage *In* AGARD Boundary Layer Effects in Turbomachines Dec. 1972 p 333-361 refs

Experimental work in cascade secondary flows accomplished in the past ten years is reviewed with the objective of pointing out difficulties common to the field. Investigations included tip clearance effects, low aspect ratio effects, and the beginnings of basic research on the influence of blade loading and inlet boundary layer characteristics on common compressor blade profiles. The objective of current investigations is to select critical configurations for in-depth study of the end-wall boundary layer development through the cascade with a view toward refining the experiment for use in the truly three-dimensional environment of a stator row. An initial experiment on end-wall flows is outlined and typical data shown. An improved technique is discussed, including test apparatus and probes to be used. Other topics discussed include an interesting method of reducing secondary flow losses (partial blade slotting) and the critical analysis of a simple, but geometrically limited, theory predicting secondary flow losses at high blade loading conditions. Author

N73-19812 Princeton Univ., N.J.

THE PREDICTION OF AXIAL COMPRESSOR PERFORMANCE WITH EMPHASIS ON THE EFFECT OF ANNULUS WALL BOUNDARY LAYERS

G. L. Mellor and T. F. Balsa *In* AGARD Boundary Layer Effects in Turbomachines Dec. 1972 p 363-374 refs

Current results are summarized in the development of a computer program to simulate axial compressor performance. The program incorporates a new theory of annulus wall boundary layers which predicts annulus boundary-layer development and losses. Aside from the work involved with the construction of

N73-19813

the program, considerable effort is being expended to diagnose existing multistage data in terms of the rather simple parameters associated with the annulus boundary-layer theory. Author

N73-19813 Cambridge Univ. (England).

PREDICTION OF ANNULUS WALL BOUNDARY LAYERS IN AXIAL FLOW TURBOMACHINES c12

M. Daneshyar, J. H. Horlock, and H. Marsh /In AGARD Boundary Layer Effects in Turbomachines Dec. 1972 p 375-392 refs

Various existing integral boundary layer methods have been examined and their predictions are compared with a wide range of experimental data. The sensitivity of the boundary layer calculations to the mainstream data input has been examined. Author

N73-19816 Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).

SHOCK WAVE BOUNDARY LAYER INTERACTION IN CASCADES c12

H. Griepentrog /In AGARD Boundary Layer Effects in Turbomachines Dec. 1972 p 441-456 refs

Experimental data obtained with compressor cascades were analyzed to determine the main parameters that affect the shock boundary layer interaction region. These parameters were found to include: (1) the displacement thickness of the boundary layer upstream of the shock, (2) the shock intensity, and (3) the pressure gradient downstream of the shock. Taking these parameters into account, a simple model of the interaction was designed. The model only considers the external effects, such as pressure distribution on the blade surface. The model presented is considered only a tentative one and further research is indicated to understand the interaction of a quasi-normal shock with a turbulent boundary layer in compressor cascades. D.L.G.

N73-19819* National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

CASCADE PLUG NOZZLE Patent Application

Blake W. Corson, Jr., inventor (to NASA) Filed 13 Feb. 1973 21 p

(NASA-Case-LAR-10951-1; US-Patent-Appl-SN-331759) Avail: NTIS HC \$3.25 CSCL 21E

An exhaust nozzle for a jet aircraft providing jet noise suppression is described. The nozzle includes a number of coaxial airfoil ring segments which are spaced serially along the longitudinal axis of the nozzle to define annular coaxial channels. The diameters of the segments progressively decrease downstream along this axis. The radial depths of the channels are small compared with the axial distance between adjacent noncoplanar channel exits, so noise is emitted nonsimultaneously from the channel exits as a series of weakened pulses staggered in time. The boattail angles of the outer surfaces of the ring airfoil segments increase in magnitude with increasing distance downstream to reduce drag. Author

N73-19820* American Airlines, Inc., New York.

AN AIRLINE STUDY OF ADVANCED TECHNOLOGY REQUIREMENTS FOR ADVANCED HIGH SPEED COMMERCIAL TRANSPORT ENGINES. 1: ENGINE DESIGN STUDY ASSESSMENT

G. Phillip Sallee Mar. 1973 110 p 3 Vol.

(Contract NAS3-15572)

(NASA-CR-121132) Avail: NTIS HC \$7.50 CSCL 21E

The advanced technology requirements for an advanced high speed commercial transport engine are presented. The results of the phase 1 study effort cover the following areas: (1) statement of an airline's major objectives for future transport engines, (2) airline's method of evaluating engine proposals, (3) description of an optimum engine for a long range subsonic commercial transport including installation and critical design features, (4) discussion of engine performance problems and experience with performance degradation, (5) trends in engine and pod prices with increasing technology and objectives for the future, (6) discussion of the research objectives for composites, reversers,

advanced components, engine control systems, and devices to reduce the impact of engine stall, and (7) discussion of the airline objectives for noise and pollution reduction. Author

N73-19821* American Airlines, Inc., New York.

AN AIRLINE STUDY OF ADVANCED TECHNOLOGY REQUIREMENTS FOR ADVANCED HIGH SPEED COMMERCIAL TRANSPORT ENGINES. 2: ENGINE PRELIMINARY DESIGN ASSESSMENT

G. Phillip Sallee Mar. 1973 78 p 3 Vol.

(Contract NAS3-15572)

(NASA-CR-121133) Avail: NTIS HC \$6.00 CSCL 21E

The advanced technology requirements for an advanced high speed commercial transport engine are presented. The results of the phase 2 study effort cover the following areas: (1) general review of preliminary engine designs suggested for a future aircraft, (2) presentation of a long range view of airline propulsion system objectives and the research programs in noise, pollution, and design which must be undertaken to achieve the goals presented, (3) review of the impact of propulsion system unreliability and unscheduled maintenance on cost of operation, (4) discussion of the reliability and maintainability requirements and guarantees for future engines. Author

N73-19822* American Airlines, Inc., New York.

AN AIRLINE STUDY OF ADVANCED TECHNOLOGY REQUIREMENTS FOR ADVANCED HIGH SPEED COMMERCIAL TRANSPORT ENGINES. 3: PROPULSION SYSTEM REQUIREMENTS

G. Phillip Sallee Mar. 1973 85 p 3 Vol.

(Contract NAS3-15572)

(NASA-CR-121134) Avail: NTIS HC \$6.25 CSCL 21E

The advanced technology requirements for an advanced high speed commercial transport engine are presented. The results of the phase 3 effort cover the requirements and objectives for future aircraft propulsion systems. These requirements reflect the results of the Task 1 and 2 efforts and serve as a baseline for future evaluations, specification development efforts, contract/purchase agreements, and operational plans for future subsonic commercial engines. This report is divided into five major sections: (1) management objectives for commercial propulsion systems, (2) performance requirements for commercial transport propulsion systems, (3) design criteria for future transport engines, (4) design requirements for powerplant packages, and (5) testing. Author

N73-19824* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

DESIGN AND EVALUATION OF COMBUSTORS FOR REDUCING AIRCRAFT ENGINE POLLUTION

Robert E. Jones and Jack Grobman 1973 19 p refs Presented at 41st Meeting of AGARD/Propulsion and Energetics Panel, London, 9-13 Apr. 1973

(NASA-TM-X-68192; E-7334) Avail: NTIS HC \$3.00 CSCL 21E

Efforts in reducing exhaust emissions from turbine engines are reported. Various techniques employed and the results of testing are briefly described and referenced for detail. The experimental approaches taken to reduce oxides of nitrogen emissions include the use of: (1) multizone combustors incorporating reduced dwell times, (2) fuel-air premixing, (3) air atomization, (4) fuel prevaporization, and (5) gaseous fuel. Since emissions of unburned hydrocarbons and carbon monoxide are caused by poor combustion efficiency at engine idle, the studies of fuel staging in multizone combustors and air assist fuel nozzles have indicated that large reductions in these emissions can be achieved. Also, the effect of inlet-air humidity on oxides of nitrogen was studied as well as the very effective technique of direct water injection. The emission characteristics of natural gas and propane fuels were measured and compared with those of ASTM-AI kerosene fuel. Author

N73-19825* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

INSTANTANEOUS DISTORTION INVESTIGATION

James E. Calogeras 1972 19 p Presented at the Tech. Interchange Meeting of Air Inlets and Diffusers Panel, Naval

Aeroballistics Comm., Dahlgren, Va., 19 Sep. 1972
(NASA-TM-X-68189; E-7329) Avail: NTIS HC \$3.00 CSCI
21E

The results obtained in an inlet-engine compatibility test run in the 10x10 SWT of the NASA-Lewis Research Center are reviewed. This program was run to measure the time-variant distortions produced in a supersonic inlet and to relate a unique distortion peak, occurring in an instant of time, to the origin of stall in a compressor. The major stumbling block in this type of effort is the determination of a proper increment of time over which to average pressures before computing distortions. It is reasonable to expect that the proper averaging time is related to the particular compressor in question. The most significant point reported is that the proper averaging time may not be solely dependent on a particular compressor, and, in fact, may vary with operating conditions, even for the same inlet-engine combination. Author

N73-19826*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
PRELIMINARY STUDY OF AN INTEGRAL FAN LIFT/CRUISE ENGINE FOR A 100 PASSENGER VTOL TRANSPORT
Kestutis C. Civinskas Jan. 1973 36 p refs Prepared in cooperation with Army Air Mobility R and D Lab., Cleveland
(NASA-TM-X-68186; E-7304) Avail: NTIS HC \$4.00 CSCI
21E

A simplified mission analysis was performed to determine an optimum engine cycle for a 100-passenger VTOL transport with a range of 500 statute miles. The aircraft had a total of eight integral fan lift engines, three of which serve as cruise engines. Fan pressure ratio was varied from 1.2 to 1.3, overall pressure ratio from 7 to 13, and turbine inlet temperature from 2460 to 2860 R. Bypass ratio was selected to meet a 500-foot altitude flyover noise goal of 95 PNdB. Airplane gross weight and direct operating cost (DOC) were calculated. The lowest DOC of 1.82 cents per seat-mile was achieved with a fan pressure ratio of 1.3, overall pressure ratio of 12, and turbine inlet temperature of 2860 R. Author

N73-19910 Oklahoma Univ., Norman.
DYNAMIC BUCKLING OF AN AXIALLY COMPRESSED CYLINDRICAL SHELL WITH DISCRETE RINGS AND STRINGERS Ph.D. Thesis
Cary Andrew Fisher 1972 134 p
Avail: Univ. Microfilms Order No. 72-23094

The structural response of light aircraft to crash loadings as a basis for crashworthy aircraft design is discussed. The investigation is based on an analysis of the dynamic buckling of discretely stiffened shells. The primary loading is identified as a suddenly applied axial compression loading of short to medium time duration. Appropriate nonlinear strain-displacement relations and equations of motion for the assumed modal shapes were developed. Response curves were plotted in the form of maximum radial deflection as a function of time. Because of the nature of dynamic buckling, the criterion was established that shell buckling occurred when a large increase in radial deflection was observed for a particular loading condition. Dissert. Abstr.

N73-19942# Defence Research Establishment Valcartier (Quebec).
ILLUMINANCE MEASUREMENTS OF AIRBORNE FLARES CFB COLD LAKE 1970
D. Pleiter Aug. 1972 81 p refs
(DREV-R-673/72) Avail: NTIS HC \$6.25

During tests of two types of flares simultaneous recordings were made of the ground illuminance at two separate locations. In the case of 11 flares of the first type and 4 of the second, effective values of the luminous intensity were obtained by combining the illuminance measurements with theodolite measurements of flare position. The effective values ranged from 10 to 20 percent lower than the intensities ascribed to the flares. In addition, some subjective observations were made of the spectra of the flares and of tactical scenes viewed through a low-light-level television system. Author

N73-19947# Bureau of Mines, Bartlesville, Okla. Energy Research Center.

EMISSION CHARACTERISTICS OF AN AIRCRAFT AUXILIARY POWER UNIT

F. W. Penn and W. F. Marshall 1973 16 p Sponsored in part by EPA
(BM-RI-7735) Avail: NTIS HC \$3.00

An aircraft auxiliary power unit (APU) was used as an exhaust source for evaluation and refinement of sampling and analytical procedures for gas turbine engines. The unit was also used to determine the emission characteristics of APU's in service and to study the effect of fuel composition and combustor design on exhaust emissions. Carbon monoxide, carbon dioxide, oxides of nitrogen, hydrocarbons, aldehydes, particulate loading, and odor were measured at engine operating modes representing the duty cycle encountered in airline operation. Analyses showed good repeatability, and adequate sensitivity was attained in these experiments. Smoke opacity measurements were not taken owing to the lack of a high-sensitivity smoke meter. Results showed that the minimum emission levels occurred with the standard combustor and jet A fuel. Emission rates were highly dependent on test mode, but emission patterns as a function of test mode were similar for all fuels and combustors tested. A comparison of three identical design production combustors showed a variation in average emission rates of less than 5 percent. Author

N73-19949*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

EFFECTS OF PREVAPORIZED FUEL ON EXHAUST EMISSIONS OF AN EXPERIMENTAL GAS TURBINE COMBUSTOR

Carl T. Norgren and Robert D. Ingebo 1973 25 p refs Presented at Spring Meeting of the Central States Sect. of the Combust. Inst., Urbana, Ill., 27-28 Mar. 1973
(NASA-TM-X-68194; E-7336) Avail: NTIS HC \$3.25 CSCI
21B

Effects of fuel vaporization on the exhaust emission levels of oxides of nitrogen (NOx), carbon monoxide, total hydrocarbons, and smoke number were obtained in an experimental turbojet combustor segment. Two fuel injector types were used in which liquid ASTM A-1 jet fuel and vapor propane fuel were independently controlled to simulate varying degrees of vaporization. Tests were conducted over a range of inlet-air temperatures from 478 to 700 K (860 to 1260 R), pressures from 4 to 20 atmospheres, and combustor reference velocities from 15.3 to 27.4 m/sec (50 to 90 ft/sec). Converting from liquid to complete vapor fuel resulted in NOx reductions as much as 22 percent and smoke number reductions up to 51 percent. Author

N73-19968 Air Force Systems Command, Wright-Patterson AFB, Ohio. Flight Environments Branch.

AIR-TO-GROUND TARGET ACQUISITION WITH FLARE ILLUMINATION c23

Robert L. Hilgendorf IN AGARD Air to Ground Target Acquisition Nov. 1972 11 p refs

This paper is concerned with the results from three recent experiments. Experiment 1 dealt with the effect of shielding a 25,000,000-lumen flare source and determining the optimal number of flares to be used for a given target area. No statistically significant effect was found due to flare shielding. For the given target area simulated, it appeared that there was no additional benefit derived from igniting more than two flares over a simulated area of about 1.5 kilometers by 5 kilometers. Experiment 2 dealt with shielding of a 60,000,000-lumen source, and again, no statistically significant effect was found due to the flare shielding. Experiment 3 dealt with the visual acuity under simulated flare light. In this experiment, each of eight groups of five subjects performed simulated observer altitude ranging in 152-meter increments from 152 to 1,219 meters. For the slant ranges simulated (1,029 to 1,587 meters), 610 meters was the best altitude for visual performance. Like the other findings, this could have significant impact on tactical planning for night missions. The parameters of this study have now been blown-up to real-world size and the Aerospace Medical Research Laboratory, in conjunction with the Air Force Armament Laboratory, is conducting flight tests to validate the altitude data of the experimental simulations. Author

N73-19970

N73-19970 Army Electronics Command, Fort Monmouth, N.J.
Avionics Lab.

**A DESIGN CONCEPT FOR A DUAL HELICOPTER NIGHT
SCOUT SYSTEM**

William J. Kenneally /in AGARD Air to Ground Target Acquisition
Nov. 1972 11 p refs

Limited but promising operational experience with helicopter-borne night vision systems (both low light level TV and forward looking infrared) has spurred an interest in the application of night vision technology to second generation airborne systems. The limited quantitative performance data on these first generation systems, coupled with the significant advances in night vision technology made during the intervening period, place severe restrictions on the system designer attempting to make logical system tradeoffs. The scope of the paper is to examine various relevant data on the subject and to develop a design concept for such a second generation scout system. Author

N73-19984* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
Guidance and Control Div.

HELICOPTER VISUAL AID SYSTEM c23

R. L. Baisley /in its JPL Quart. Tech. Rev., Vol. 2, No. 4 1973

p-72-86 ref

CSSL 20F

The results of an evaluation of police helicopter effectiveness revealed a need for improved visual capability. A JPL program developed a method that would enhance visual observation capability for both day and night usage and demonstrated the feasibility of the adopted approach. This approach made use of remote pointable optics, a display screen, a slaved covert searchlight, and a coupled camera. The approach was proved feasible through field testing and by judgement against evaluation criteria. Author

N73-19988# Deutsche Forschungs- und Versuchsanstalt fuer
Luft- und Raumfahrt, Porz (West Germany).

**[ORGANIZATION OF DFVLR AND RESEARCH ACTIVITIES
DURING 1971] Annual Report, 1971**

1971 494 p refs In GERMAN

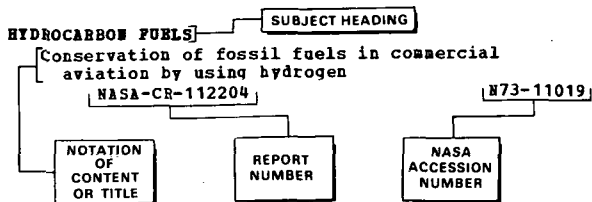
Avail: NTIS HC \$26.75

The organization and management of the society are outlined and research work is reported in the following faculties: fluid mechanics, aeromechanics and flight control, solid materials and construction methods, propulsion and energy, electronics, aerospace physics, space simulation, and aerospace medicine.

Transl. by G.G.

SUBJECT INDEX

Typical Subject Index Listing



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A

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An international review of civil aircraft damaged or destroyed by deliberate detonation of explosives /sabotage/ 1964-1972.

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Nelson Tyler helicopter camera mount for aerial reconnaissance photography providing camera balance and motion stability under combat flight conditions

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AERIAL RECONNAISSANCE

Nelson Tyler helicopter camera mount for aerial reconnaissance photography providing camera balance and motion stability under combat flight conditions

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A73-22434

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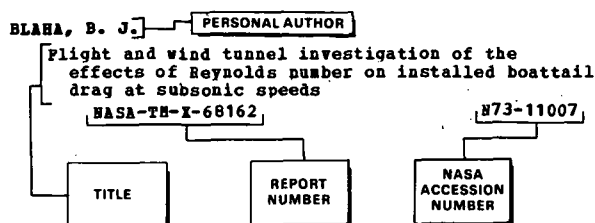
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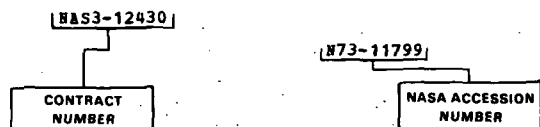
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